Vol 1 Compl,
no Index published Yet

PAVING AND MUNICIPAL ENGINEERING.

A Journal Devoted Specially to Street and Sidewalk Paving, Water Works Construction, Bridge Building, Street Lighting, Sewerage and all Matters Pertaining to Public Improvement in Cities.

VOL. I. INDIANAPOLIS, IND., MAY, 1891. No. 12.

Warren-Scharf Asphalt Paving Comp'y

CONTRACTORS FOR

* * * * PAVEMENTS *Of Genuine Trinidad Asphalt.*

OVER five millions square yards, equal to about 285 miles of street thirty feet wide, in successful use in over forty cities of the United States and Canada. For full information and estimates, apply to . . . . . .

THE IDEAL PAVEMENT OF MODERN TIMES
NO LONGER AN EXPERIMENT
EXPERIENCE HAS ESTABLISHED
ITS SUPERIORITY.

WARREN-SCHARF ASPHALT PAVING COMPANY, 81 FULTON STREET, NEW YORK,
OR 23 BLYMYER BUILDING, CINCINNATI, OHIO.

The Indianapolis Paving Exposition

Embracing the Largest and Finest Collection of Specimens of Paving in the World, will, on account of its value and beneficial influence in stimulating a spirit of public improvement, be continued indefinitely under the management of the Commercial Club of Indianapolis, the organization which originated the idea and made the Exposition a success. **Exhibits of more than sixty of the Leading American Paving Companies.** New exhibits are being added, and the Exposition will be enlarged and improved in every way possible. Companies not already represented are invited to send exhibits, but no paving material regarded by the committee in charge as being without merit will be admitted to the Exposition. Exhibits must, in all cases, be shipped with freight charges prepaid. The assurance can be given that more can be learned about paving at this Exposition than by visiting a dozen of the best paved cities in America.

ALL cities in the United States are invited to send committees or official delegations to Indianapolis to avail themselves of the unequaled advantages afforded by the Exposition for GATHERING KNOWLEDGE OF PAVING. . . . . .

A TWO-CENT STAMP SHOULD BE SENT with requests for COPIES OF THE REPORT OF THE PAVING EXPOSITION.

FOR FURTHER INFORMATION, ADDRESS THE COMMERCIAL CLUB, INDIANAPOLIS, INDIANA.

M. S. HUEY, GEO. N. CATTERSON, WILLIAM C. BOBBS, Paving Exposition Committee.

THE SOUTHERN GRANITE CO.,

GEORGE MOERLEIN, President.
JOHN GOETZ, JR., Vice-Pres't.
J. A. EBERHARDT,
Sec'y, Treas. & Gen. Mgr.

General Contractors in • **GRANITE.**

QUARRIES AT
LITHONIA, REDAN AND
ROCKDALE, GA.

Street Paving Work a Specialty.

20 KIMBALL HOUSE BLOCK,
ATLANTA, GA.

OFFICES

19 & 20 WIGGINS' BLOCK,
CINCINNATI, O.

THE BEST AND CHEAPEST

Interstitial Filling for any kind of Block Paving,
Stone, Brick, Wood or Cobblestone, is

Murphy's Grout Filling

It has been in Use in Columbus, Ohio, for Six Years,

Under the heaviest traffic, without any signs of wear being perceptible. It has been adopted for use hereafter in all block paving.

A secret of success in Block or Brick Paving is the use of interstitial filling that will wear without breaking. Mr. Murphy has discovered the secret. His Grout Filling makes the most durable pavements, as experience with it demonstrates. It is not only infinitely better than coal-tar, but it is forty per cent. cheaper in cost. For full information address

JOHN MURPHY, Patentee, 373 Lazelle Street, Columbus, Ohio.

Pavements and Roads

Their Construction and Maintenance.

By E. G. LOVE, Ph. D.

Large 8vo., pp. 410; handsomely bound in cloth.
Sent post-paid on receipt of $5.00.

ADDRESS PAVING AND MUNICIPAL ENGINEERING
CHAMBER OF COMMERCE, INDIANAPOLIS, IND.

A TREATISE
ON
Masonry Construction.

BY IRA O. BAKER, C. E.,
Professor of Civil Engineering, University of Illinois.

Cloth, 6 × 9 inches. 552 + xv. pages; 160 figures, many of which are full page; 6 folding plates; 87 tables of costs, strength, contents, etc. Copious index. The book contains the results of a great number of experiments, and a large amount of practical data on the cost of masonry, pile driving, foundations, culverts, etc., and also many tables of contents to facilitate the making of estimates,—all prepared especially for this volume.

PRICE, POST-PAID, $5.00.

FOR SALE BY

Paving and Municipal Engineering,
INDIANAPOLIS.

WITH GOOD PAVEMENTS
SHOULD GO GOOD WHEELS.

The BEST WHEELS are always BEST either on good or poor roads.

Columbia Cycles

HIGHEST GRADE ONLY.

CATALOGUE FREE.

BRANCH HOUSES:
12 Warren Street, New York.
291 Wabash Ave., Chicago.

POPE MFG. CO. 77 Franklin St., BOSTON. Factory, Hartford, Conn.

Tippett & Wood

BUILDERS OF

IRON BRIDGES

Turn Tables, Stand Pipes, Water Towers,
Steam Boilers, Digestors, Rotary Boilers,
Tanks, Stacks, Etc., Etc.
General Contractors in Iron Work.

Phillipsburg, New Jersey, U. S. A.

F. B. DEARINGER. C. S. NIEMIER.

Dearinger & Niemier,

Floors for Warehouses, Cellars, Machine Shops, Sidewalks, Curbing, Etc. Also, Cisterns, Vats, Pipe and Brick Sewers.

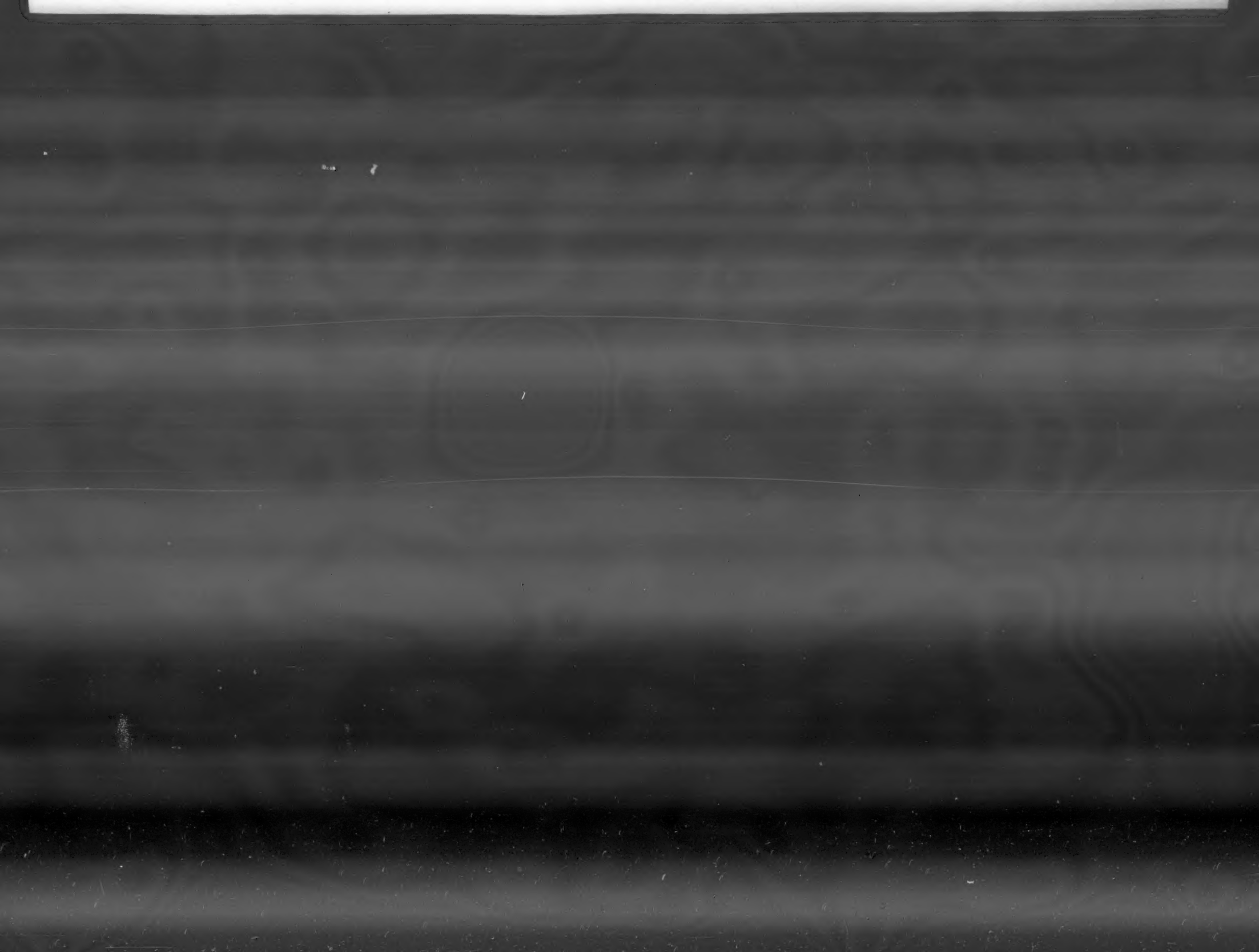
Concrete Foundations,

Artificial Stone Contractors,

Portland and Keene's Cement Work.

No. 313 East Georgia St. Shop on Bates Street, between Liberty and Noble.

Indianapolis, Ind.



Indiana Bridge Co.

DIRECTORS.

C. M. KIMBROUGH, Pres. & Gen. Mgr.
JOHN R. MARSH, Sec. & Treas.
A. L. JOHNSON.
GEO. F. McCULLOCH.
T. F. ROSE.

MANUFACTURERS OF

WROUGHT IRON BRIDGES AND IRON SUB-STRUCTURES,

MUNCIE, INDIANA.

IRON ROOFS, VIADUCTS, AND GIRDERS.

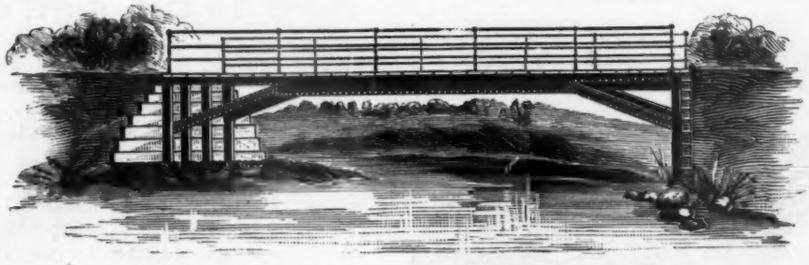
WE SELL ONLY OUR OWN MANUFACTURE.

Wrought Iron High Truss Bridge, one Span, 210 feet, over Mississinewa River, at Sharon, Delaware Co., Ind.

WE BUILD ANY KIND OF IRON BRIDGES WANTED.

CAN GIVE SATISFACTORY REFERENCE TO LARGER AMOUNT AND GREATER VARIETY OF WORK DONE IN INDIANA THAN ANY OTHER BRIDGE COMPANY. WE ARE THE ONLY COMPANY OPERATING SHOPS IN THE STATE.

NOTICE OF LETTINGS SOLICITED.



WE INVITE INSPECTION OF OUR SHOPS FOR EFFICIENCY AND CAPACITY.

ABOVE CUT SHOWS OUR PATENT LEG BRIDGE.

OVER TWO HUNDRED IN USE IN THIS STATE.

The best Bridge for spans up to 70 feet. Address all communications to

INDIANA BRIDGE CO., MUNCIE, INDIANA.

GALESBURG PAVING BRICK.

The demand for these Celebrated Brick has hitherto far exceeded the supply. By the erection of one of the largest and most complete plants in the country, the PURINGTON PAVING BRICK COMPANY expects to be able to furnish these Brick in any desired quantity, and to fill all orders promptly and satisfactorily.

Prices and samples furnished on application to

PURINGTON PAVING BRICK COMPANY,

First National Bank Building, Galesburg, Ill.

LONDON PAVING BRICK.

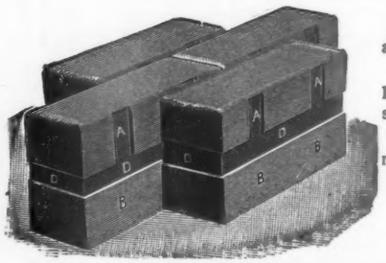
THESE BRICK are gaining a national reputation for toughness, and resistance to abrasion and the action of frost. LONDON PAVING BRICK have won the laurels in many severe tests, and to-day stand at the head of the list of vitrified paving brick in this country.

Our capacity and shipping facilities are such as to enable us to fill orders promptly. Contractors should make a note of this when wanting large quantities.

SEND FOR SAMPLES AND PRICES

London Clay Co., London Mills, Ill.

The · Arnold Street · Paving · Block.



☞It possesses real merit, absolutely water-proof.

Easily and cheaply made. Little sub-structure necessary.

☞A few works wanted to manufacture.

Address

P. ARNOLD,
CANAL DOVER, O.

THE

Ottawa Fire Clay & Brick Co.

OTTAWA, ILL.

MANUFACTURERS OF

Vitrified Paving Blocks

FOR STREETS, ALLEYS, SIDEWALKS, ETC.

QUALITY UNEXCELLED.

FIRE BRICK, FIRE CLAY, ETC.

Prices quoted on application. Correspondence solicited.

STREET SEWER RINGS,

WITH CLOSED OR PERFORATED COVERS

☞Send for Circulars and Prices.

EWALD OVER, INDIANAPOLIS, IND.

MANUFACTURER OF

STREET SEWER RINGS AND COVERS,
FIRE CISTERN RINGS AND COVERS,
CISTERN RINGS AND COVERS IN GENERAL,
CAST AND WROUGHT IRON GRATINGS,
VILLAGE HAND FIRE ENGINES,
IRON FENCES, SHUTTERS, ETC.

ALSO

Road Machinery,

Such as Four and Two-Wheeled Road Graders, Road Plows, Wheel and Drag Scrapers, Surface Ditching Plows and Graders, One and Two-Horse Surface Graders and Levelers, etc.

"GILSONITE"

Paving Cement

THE FINEST SPECIES OF

NATURAL ASPHALT

No Coal-tar Product.

Absolutely Free from Sediment.

FOR INTERSTITIAL FILLING WITH GRAVEL OF

BRICK, WOOD or GRANITE PAVING

SUPERIOR TO ANY OTHER MATERIAL FOR THE PURPOSE.

CORRESPONDENCE SOLICITED.

The Gilson Asphaltum Co.

328 ODD FELLOWS' BLDG.

ST. LOUIS, MO.

A. H. PERKINS, President. W. D. HITCHCOCK, Vice-President. V. W. FOSTER, Sec'y & Treas.

THE WESTERN

PAVING and SUPPLY

COMPANY.

CONTRACTORS FOR

GENUINE TRINIDAD ASPHALT PAVEMENTS,

AND DEALERS IN

PAVING MATERIALS,

Room 33 Ingalls Block, INDIANAPOLIS.

OFFICE TELEPHONE 757. Yard & Works: Cor. Michigan & Indiana Ave. TELEPHONE 380.

S. H. SHEARER, Manager.

PRINCIPAL OFFICE, CHICAGO, No. 8 The Rookery. DETROIT OFFICE, Cor. Jefferson Ave. and Griswold St.

CHAS. W. SAACKE,

Importer · of · Rock · Asphalt,

—DEALER IN—

PAVING MATERIALS.

SOLE AGENT FOR

The German Asphalt Co., Mines at LIMMER and VORWOHLE; H. & A. B. Aveline & Co., Catania, Sicily.

58 Pine Street, New York

Agents for Different States or Cities Solicited.

ASPHALT. ASPHALT.

THE BARBER

Asphalt Paving Co.

The Oldest and Largest

Asphalt Paving Company in the United States; has laid Asphalt pavements in twenty-seven cities of the Union, on 607 streets of a length of 255 miles, or an area of 3,916,574 square yards. It has laid more pavement in twelve years than all other Asphalt Paving Co's in Europe and America Combined have laid in thirty years.

General Offices, No. 1 Broadway, New York.

LE DROIT BUILDING, WASHINGTON, D. C.

THE BEST PAVING MATERIAL

The sapless paving blocks made by us make the best and most economical pavement before the public to-day. We can prove it by hundreds of testimonials. Blocks furnished by the car load anywhere. Our second quality blocks are the best and cheapest for repairing block pavements, or for a substantial floor in warehouses and the paving of private alleys and driveways. Ask for prices.

ROSS SAPLESS BLOCK PAVING COMPANY,

SAGINAW, E. S., MICHIGAN.

IMPROVED····

A. C. DANNER, President.
GEO. W. ROBINSON, Vice-Pres't.
J. C. STRONG, Sec'y and Treas.

Wood Pavement Co.

MOBILE, ALA.

OWNERS OF THE PATENT RIGHTS FOR MANUFACTURING THE CYLINDER SAPLESS

WOOD PAVING BLOCKS

FOR THE STATE OF ALABAMA, AND FOR MAKING AND LAYING

—THE—

"Ferrolithic" Artificial Stone.

WRITE FOR ESTIMATES.

Contractors for Paving Streets and Sidewalks with the best and cheapest Pavement known.

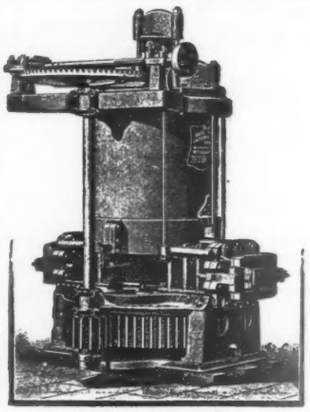
J. W. Penfield & Son.

WILLOUGHBY, OHIO. U. S. A.

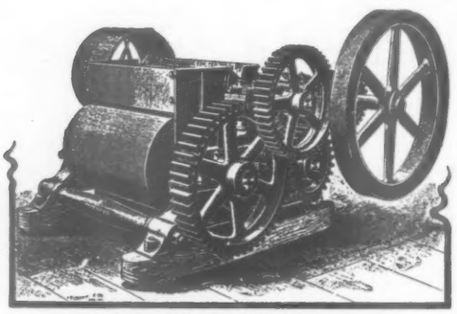
Manufacturers of

CLAY WORKING MACHINERY.

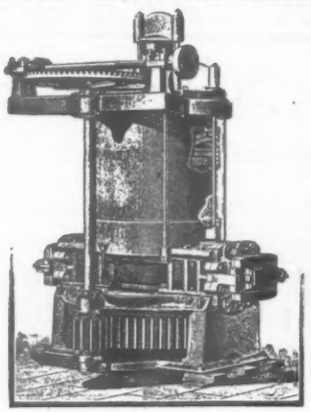
BRICK AND TILE MACHINES OF ALL SIZES AND CAPACITIES.



No. 20 A BRICK MACHINE
Capacity 60 000 Brick per day

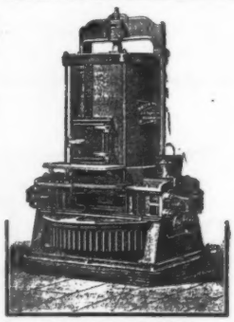


No 10 S DIFFERENTIAL MOTION SMOOTH ROLL CRUSHER
Size of Rolls, 24 x 20 inches Estimated Weight, 12,000 lbs.

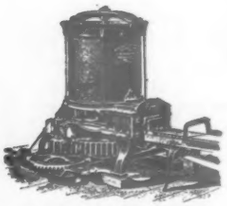


No 20 B BRICK MACHINE

OUTFITS FOR MAKING PAVING BRICK, FIRE PROOFING AND TERRA COTTA LUMBER A SPECIALTY



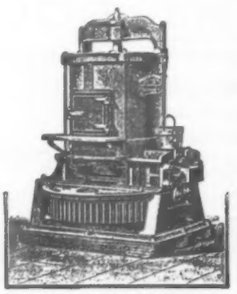
No 15 D BRICK MACHINE



No. 7 SPECIAL BRICK MACHINE

No 2 S HORSE-POWER BRICK MACHINE

No 6 SPECIAL TILE MACHINE

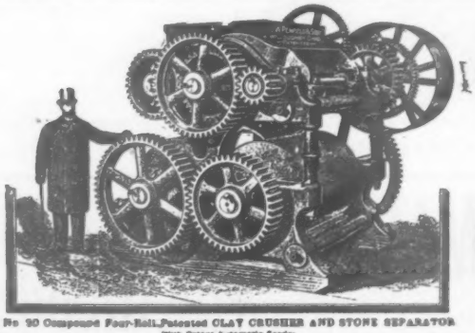


No 15 S BRICK MACHINE

THE LARGEST LINE OF CLAY CRUSHERS MANUFACTURED.

Cast Rings and Covers for Crowned Kilns

Combined Kiln and Ash Doors



No 20 Compound Four-Roll Patented CLAY CRUSHER AND STONE SEPARATOR
With Patent Automatic Feeder

Line SHAFTING, Cast PULLEYS, Couplings, Hangers and KILN Castings.

FOR FULL PARTICULARS ADDRESS

J. W. PENFIELD & SON,

WILLOUGHBY. OHIO, U. S. A.

PAVING AND MUNICIPAL ENGINEERING

A Journal Devoted Specially to Street and Sidewalk Paving, Sewerage, Water-Works Construction, Street Lighting, and all Matters Pertaining to Municipal Engineering.

Published on the 15th of Each Month.

WILLIAM FORTUNE, Editor. - - - WILLIAM C. BOBBS, Business Manager.

OFFICE: ROOM 44, CHAMBER OF COMMERCE, - - - INDIANAPOLIS, IND.

Entered at the Post-office, Indianapolis, Ind., as second-class matter.

SUBSCRIPTION: { One Year, ... $1 00. Single Copy, ... 10.

Advertisements to insure publication should reach the publication office not later than the 5th of the month.

Communications are invited, and all requests for special information on the subjects treated by this journal will receive careful attention.

Articles relating to the different branches of municipal engineering are desired. Stamps should accompany manuscripts for return postage if unavailable.

Vol. I. INDIANAPOLIS, IND., MAY, 1891. No. 12.

CONTENTS.

PAGE.

The Inauguration and Execution of the Work of Brick Paving..*Chas. P. Chase, C.E.* 231
The Various Pavements of Foreign Cities.....*Louis H. Gibson.* 232
Wood Pavements from a Sanitary Point of View.....*A. C. Danner.* 233
The Promotion of National, State and City Roads.....*W. L. S. Bayley, C. E.* 234
Experience in Street Paving..... 234
Water Mains and Sewers at Providence, R. I..... 236
Testing Paving Stones..... 236
The Parisian Subway..... 237
California's Asphalt Mine..... 237
Seaboard Road Association..... 238
Brick Paving in Memphis, Tenn..... 238
Highway Improvement in New York..... 239
Needed Road Legislation..... 239
An Opinion Regarding Paving Brick..... 239
Parker's Patent Cement.....*W. L. S. Bayley, C. E.* 239
The Paving Brick Trade..... 239
Personal..... 239

IMPROVEMENT AND CONTRACTING NEWS—
Paving..... 240
Sewerage..... 241
Water-works..... 241
Bridges..... 242
Street Lighting..... 242
Street Railways..... 243

The columns of this publication are open to the discussion of all subjects relating to paving, sewerage, water-works, street-lighting, and the physical improvement of cities. Practical information as to the merits of materials used in such work and new methods, with photographs and drawings, which may be used for illustration, are especially desired. We are glad to get brief notes as to proposed improvements and the letting of large contracts.

City engineers are requested to send us as early as possible copies of their annual reports, which will be given proper notice.

Articles relating to methods of road making and maintenance are invited.

THE INAUGURATION AND EXECUTION OF THE WORK OF BRICK PAVING.

By Chas. P. Chase, City Engineer, Clinton, Iowa.

[Concluded from April Number.]

As a general rule, the contractors for municipal work are men of extraordinary intelligence, experience and financial responsibility, but they are not in the business for glory or amusement, but for money and all they are entitled to, and a few of them for more, and it sometimes occurs, with some contractors, that their most obdurate "bulldozer" and bland "softsoaper" is sent out to get all the money possible out of the job, regardless of the fulfillment of the contract.

He begins with "sizing up" the engineer in charge. If he is mature, experienced and honest, he generally lets him alone; but if he is young and inexperienced, he applies the influence most likely to accomplish the desired result, generally the milder one first. The engineer is complimented on his skill and remarkable adaptability for practical work; he is "wined and dined" and given extra work for a liberal compensation, until he is ready to believe the superintendent to be the most liberal fellow in the world and "bound to do a good job, if he don't make a cent." With this foundation laid in the right locality, he starts out to "skin the job," applying "hard and soft" along the line among the "kickers" to suit the case. The brick fly; the men trade, by advice of the superintendent, with the neighboring merchants; business is brisk; every one that "kicks" has a free lunch or a drink; all defects are covered up as much as possible as the work progresses. Hurrah The job is done. The engineer, "nice fellow," certifies to the *completion* of the work; the tax is levied, bonds issued and money or bonds paid to the superintendent, who is received at "headquarters" with royal sumptuousness for having succeeded in "wooling" the engineer and the people and "skinning the job," while the engineer soon discovers that through his incompetency and indecision his employers, the people, have lost many thousands of dollars, perhaps, and his remorse is so great that the nearest sewer is too far away and too comfortable for his quick and appropriate concealment.

To avoid such a calamity, let the engineer be competent, careful, energetic, honest and firm, but kind. Let him watch every part of the work and insist upon a substantial fulfillment of all the material specifications, and, if necessary, give the superintendent to understand, in a proper manner, that a final certificate can not be obtained without a completion of the work as agreed. At the same time, if the skillful workman can devise a *short cut* to accomplish the same substantial result, he is entitled to the benefit of his device, though technically at variance with the specifications. Good judgment and common sense can be safely mixed with the specifications, but if the engineer is short of these ingredients, he had better stick to the specifications.

THE CURBING

Should be set and bedded in clean sand, or on concrete, before the subgrade is prepared (unless the street is to be cut down), and back-filled with six inches of sand, to guard against the action of the frost, and back of that, for two or three feet, and extending over it and opposite the joints, should be placed such earth as will prevent the water from passing through the joints, which joints should be cemented with hydraulic cement as an additional precaution to prevent the water from passing through the joints and taking the sand from under the brick. The sand is an excellent cushion and bed for the brick, but it *must* be confined within the curbing.

SUBGRADE.

If the earth of the street to be paved is wet and clayey and drainage slight, it should be tile-drained along the gutters or in the center of the street, according to the width of the pavement and amount of water in the earth; but if surface drainage is good, or the earth sandy or gravelly, no under-drainage will be necessary, but in either case the subgrade should be put in the same shape as the pavement when completed—that is, a fall of from six to eight

inches (or as desired) from center to gutter, in a forty or fifty foot pavement. If the earth is to be excavated, it should be "skinned off" to the proper grade without loosening the remaining earth, and rolled down. If the grade is to be made by filling, it should be leveled off and puddled and well rolled, with a heavy iron roller (seven or eight tons at least) every four or six inches of earth, and well tamped with a heavy iron tamper where the roller can not be used, especially along the gutters. *Suitable* material *must* be used. Nothing like quicksand, clay or any material that will become soft and in which the pavement will sink, should be used for the subgrade; and to guard against this, the last six inches of the subgrade, unless the earth is very dry, sandy, or gravel, and surface drainage good, should be of rubble filled with sand or gravel, as hereinafter specified for one course of brick, and when completed should be evenly rounded up to the proper grade and rolled hard, so that there will be no hollows for any water, that may possibly pass through the pavement, to stand in, and upon this subgrade, for a

TWO COURSE PAVEMENT,

Place about four inches, or, in case the six inches of rubble or gravel is used, two inches of clean, sharp sand, brought to the same shape as the subgrade, and on this lay, flatwise and lengthwise of the street, a course of brick to be tamped the same as top course; on these brick place two inches of same sand brought to same shape, and on this lay one course of best paving brick, edgewise of the brick and crosswise of the street, and on the top course of brick sweep into the crevices between the brick sufficient fine sand to fill them about half full, and take a three inch plank about twenty feet long and turn from gutter to gutter, tamping back and forth at each turn, with a heavy wooden tamper, until the unevenness is all taken out, and then roll the whole with the iron roller, and, finally, spread on three-fourths of an inch of sand and leave it to be driven into the crevices by travel, and remove at pleasure. For a

ONE-COURSE PAVEMENT,

On the same subgrade place six inches of rock broken into pieces from one to three inches in diameter (longest way), and mixed with coarse sand as put on, and more added on top, or all put on top, and in either case well washed in with the hydrant hose, and all rolled down solid with the iron roller and well tamped with the iron tamper, where the roller can not be used, especially along the gutters, and all depressions filled with fine rock and sand, until a hard, even surface of the desired shape for the street is produced; or coarse gravel (with all vegetable matter screened out and coarse sand substituted), packed and rolled in the same way, may be substituted for the rock and sand, and on this spread two inches of coarse, clean sand, and lay one course of best paving brick, and finish up the same as for two courses.

This pavement, if well laid, is equally as good as two courses and, in localities where rock (which need not be very hard for ordinary travel) or gravel is plenty, is much cheaper. With the foundation thoroughly prepared, there seems to be no doubt but that a pavement made of the best quality of brick for that purpose is the most durable and satisfactory pavement now known for the money it costs.

ENGINEER'S REPORT.

When the work is completed, the engineer should report to the proper officers of the corporation a specific statement of the amount and cost of the work, the amount to be assessed to abutting property, and the amount to be paid by the corporation, and from this

THE ASSESSMENT ROLL

is made up, which should contain a brief description of each piece of property and the amount to be assessed thereto, and the name of the owner, and notice given to such owners (as the ordinance and law may require) to appear and make objections, if any, thereto, and when all corrections are made, a resolution or ordinance (as the case may require) should be adopted levying the tax, and issuing bonds (if any are desired and authorized by law), and settlement made with the contractors.

And if all parties have discharged their whole duty, a noiseless, wholesome, reliable pavement has been obtained that will outlast a generation, except, possibly, in large cities where there is heavy traffic; and we believe that the time will soon come, if not now, when paving brick will be made more durable than granite blocks.

NOTE.—A competent civil engineer should be in charge of all the improvements contemplated by this article, to insure good work and economy.

THE VARIOUS PAVEMENTS OF FOREIGN CITIES.

By Louis H. Gibson.

I NOW feel that I am able to speak, in a comparative way, of the various street pavements which I have seen. For nearly four months I have spent a part of each day examining, studying and asking questions about street pavements. I have seen them under varying climatic conditions.

In Glasgow nearly all of the pavements are of granite. A few streets are covered with wooden blocks, and one sees a less number with asphalt. The same is true of Edinburgh. Belfast is the only city in which I noticed any large amount of macadamized street. In Liverpool there is much granite pavement, though more wood and asphalt than in Glasgow. In London there is a large variety of pavements but many are sadly neglected. Paris is the best city that I have yet seen in which to study this question. Here we have asphalt, granite and wooden block coverings variously constructed. Granite pavements are very noisy, nearly always slippery, not long-lived and difficult to clean. The interstices between the stone, even where the joints are made with bitumen, gather and retain filth. The edges become rounded off in a short time and the blocks require re-dressing. If that stone can be re-dressed it is in the long run less expensive than some other materials. The fact, however, that it is not clean, that it is very slippery and very noisy will always make them unpopular. The granite pavements of Glasgow are superior to those of any other city, not only on account of the attention which they receive, but because of the character of their construction. All granite pavements in Glasgow rest on a six-inch bed of concrete, made with broken stone and cement, or broken stone and bitumen. Many of the streets of the other cities which I have named have the stone blocks on a sand bed, and in all such cases the streets are uneven and generally in bad shape. This is particularly true of Paris. Nearly all the granite streets here rest on a sand bed, and they are very uneven. There is only one street that I know of where the blocks rest on a concrete base. This gives a most excellent opportunity for comparison. But even here it does not compare well with the wooden pavement, which, by the way, is being subjected to a revival on this side. Some of the heaviest-traveled streets in Paris are covered with wooden blocks. The principal objection to the wood pavement is that it absorbs, to the point of saturation, all of the filth that comes in contact with it, and for this reason is always a stinking, offensive pavement, no matter how clean the surface may be. With a light snow a wooden pavement is very slippery. It is bad enough on a cold day when a little damp. The best block pavements in Paris rest on an eight-inch concrete bed. Many of the blocks are put together dry, though some of them have the joints filled with strips of wood at the bottom, which reach about half way up, and are filled with pitch to the top. Many blocks are saturated in creosote before being put down. The advantage which is claimed for this pavement is its long life, its relative freedom from noise, and the fact that it is easier on the horses' feet. It must not be forgotten, however, that at times a wooden pavement is quite as slippery as any that can be put down.

Paris excels in asphalt pavements. They, too, are noisy, but are long lived and clean. While they are hard on the horses' feet, they are not nearly so bad as the granite. If sprinkled with sand during cold or damp weather, they are not so slippery as wooden pavements under similar conditions. The construction of a Paris asphalt pavement is very simple. There is an eight-inch bed of Portland cement concrete, and a two and three-quarter inch layer of asphalt composition. That is, asphalt with a certain amount of

gravel and sand. This general construction is quite different from what we are used to. Our Ohio-street pavement is something on this order, though very much more complicated. This pavement, if I remember correctly, had first the five-inch layer of concrete, then two coverings of the composition.

I find, on further investigation, that some of the sidewalks are covered with asphalt and others with bitumen. Those recently made, and which have the thin covering, are of bitumen, which material, being used in its natural state rather than as a composition, can be remelted. I find that the specification for this covering calls for three quarters of an inch of bitumen. This accounts for the fact that some parts of it are about five-eighths of an inch thick and others nearly an inch.

I have seen wooden pavements in Great Britain on a sand-bed, but in all such cases they were faulty. I think it is fair to say that no pavement which rests directly on a sand-bed, or, to put it specifically, no pavement which does not rest on a concrete bed, is satisfactory. The concrete is economical in that the surface can be renewed without the expense of a new bed.

I happen to know that the makers of brick pavement in America are preparing to build streets with sand beds—some of them with, first, a layer of sand or cinders, six or eight inches deep; then a course of brick laid flat on top of this, a two-inch covering of sand, and finally the brick set on edge. It is my judgment that a brick pavement, in order to succeed, will have to have a solid concrete bed. Brick has less bearing surface than other blocks, and is, therefore, certainly liable to any faults which may belong to any other block pavement without the solid foundation. I believe that brick pavement will only be satisfactory if laid on a solid concrete bed with Portland cement joints. Then, if the bricks are vitrified, it will be quite as impervious to water as asphalt, and altogether a very satisfactory pavement. Certainly nothing could be cleaner. The only question, then, between brick and asphalt will be cost.

Brick pavements are used here in stables for heavy horses. The bricks are laid on a seven-inch bed of concrete and in Portland cement. Sometimes there is a layer of sand over the cement, but in this instance the cement is slushed into the joints in a way that practically amounts to having a good portion of this upper sand covering converted into cement concrete, this being done by the cement slush running through the joints and into the sand. In the stables of which I speak the joints in the bricks are laid lengthwise of the stalls, and are rodded down so that they are about half an inch below the top of the brick. This makes all the longitudinal joints which run toward the tail of the stall take the place of little gutters, which carry all the water to the large gutter in the rear of the stall. It is said that these brick pavements in the stables are almost everlasting. I have as yet been unable to learn why they have not been used in Paris on the streets. They would certainly be easier cleaned than others, the vitrified surface being particularly advantageous in this way. Before putting down brick we should know that the surface is thoroughly vitrified.

I wish to emphasize, by repetition, the statement that no street is satisfactory which does not rest on a concrete bed. The concrete need not necessarily be of cement. It should, however, be of cement or bitumen, and should be made of broken stone or gravel, sand and cement or the bitumen.

I was talking to a gentleman recently about streets. He had traveled not a little and had studied this question for the benefit of a city in Scotland in which he lived and where he was a member of one of the improvement boards. He said: "You must be exceedingly careful in transmitting information about street building from one city to another. Conditions are so various that what may do quite well in one city will not be at all applicable to another. For instance, we will say that Paris has an eight inch concrete foundation under her block pavements. Now, that does not imply that all cities should use an exactly similar foundation. Eight inches will do for a part of Paris, and in other sections they have to make special preparation. In our city in Scotland we do not need so much. The travel is not so heavy, and we have a better natural foundation. Again, there are other sections where there is a soft, loamy soil, where it will be necessary to roll it well with a heavy roller, and then put on top of that a broken stone, concrete bed. However, I believe that a rolled bed, and the eight-inch concrete applied directly, will always be sufficient for anything which will come over it.

"You will find in Brussels a great many macadamized streets and in a location where there is plenty of stone and gravel. I can see no reason why they should not be used for the large majority of streets. Certainly they are better than anything else for horses and smooth driving. I would not be surprised that some of these days we would come to the conclusion that we have overlooked the best paving material in the world to take up with something more elaborate."

"Are they not very dusty?" I asked.

"Very dusty, yes; but that is a question of water and keeping them clean. You can wash and sweep them clean the same as any other street."

"How about repairs?" I suggested.

"Repairs on a macadamized street are the simplest thing possible, providing you do not wait for the street to degenerate into a series of ruts. With a little care the constant slight repairs necessary will simply add to the perfection of a macadam street. They make it everlasting; repair means renewals. It gets better with age."

"Should they be rolled?" I asked.

"Again I will say that it is hardly possible to give a general rule. The foundation, if not good, should be rolled, and the finishing with a heavy roller makes it available for comfortable travel at once. The advantage about a macadamized street is that it is not particularly noisy and is the best city road we have for horses, and like any other street, can be kept clean with water and proper attention. In order to keep a street clean we have to sweep and wash it the same as we do a house."

WOOD PAVEMENTS FROM A SANITARY POINT OF VIEW.

By A. C. Danner.

THERE has been a theory in the minds of a great many people through the United States that the paving of the streets of a city with wood would cause sickness. This theory seems to have been exploded entirely since the recent census. The vital statistics of cities of the United States, compiled from returns made by the health officers of the respective municipalities, show that the lowest death rate per thousand of any city reported in the United States is that of Duluth, Minnesota, the rate there being only 9.17 deaths per thousand for the year 1890. Duluth is paved entirely with wooden blocks.

Then take the great cities of the United States, say New York, Chicago, Boston and Philadelphia. Chicago is paved almost entirely with wooden blocks, having more than two hudred and seventy-five miles of wooden block pavement within its limits. Chicago's death rate is much lower than either of the others, showing for 1890, 17.48 deaths per thousand, while New York, for instance, shows 25.19, Boston, 23.31, and Philadelphia, 19.74, the last named cities being paved with stone and asphalt, but little wood pavement.

Then take cities of a smaller size. Detroit, for instance, paved with wooden blocks, has a very low death record, 14.70 per thousand, while Cincinnati, that has clung to the old-fashioned stone pavement, has 20.06, and so it goes, strange to say.

"Memphis, Tenn., largely paved with wood, has a very low death rate, only 16.36 for the year 1890, while Nashville, paved with brick and stone, has a death rate of 23.70, and Atlanta, with great natural health advantages, and paved with stone, has a death rate higher than that of Memphis, viz: 19.87."

These statistics may not prove that there is anything unhealthy connected with stone or asphalt, but they certainly demonstrate that wood pavement does not cause an increase in the death rate.

Both Chicago and Detroit have had wooden pavement for years, blocks actually put down with the sap on; they have worn out, decayed, and been renewed with more wood, and yet these cities have the best health record of any cities of like size in the United States.

THE PROMOTION OF NATIONAL, STATE AND CITY ROADS.

By W. L. S. Bayley, C. E.

"The same thing is the same
Whenever and wherever made."

IN the great speech made by Henry Clay in the House of Representatives, October, 1818, the orator said: "We contend for the national power to make roads and canals, that thereby may be distributed the intelligence, the force and the productions of our common country through all its parts, and with this right we only ask for such government supervision as will enable the authorities to keep the same in order and prevent decay." More than once in those days did the congress pass bills for internal improvements, predicated upon the above assumption by Mr. Clay, only to be estopped by "constitutional objections" at the desk of the President of the United States. With a vein of sarcasm, it was the President's custom to voluntarily say, "Appeal to the people for an amendment to the Constitution if you want internal improvements." The sting of party hate was but lightly buried within the folds of this specious advice. While it was well known by the real friends of the measure that they might be caught between the upper and nether millstone, because of the fact that, while a large and powerful party thoroughly imbued with political sentiments, which always had, and always would oppose any effort of the government toward internal improvements as such, would stand shoulder to shoulder with the President, the friends of the measure,—many of them at least,—with full faith that the rights asked for were already granted by the Constitution, would claim that it was, or would be, a work of supererogation to enact an act which already existed.

Thus matters drifted, till the war with Mexico in 1847 called the attention of all the people to the distant field of strife. It is not necessary, if it were possible, to show to what extent slavery and its adjunct, aristocracy, blocked every effort for even the improvement of our post-roads, a provision especially enumerated in the Constitution. Certain it was and is that, with a few notable exceptions, the government was not allowed to build a road or a canal which did not have "the smell of salt water on its garments." The great orator was laid to rest with his work undone, save the building of the National road, while history was being written with electrical speed. When the war of the Rebellion forged to the front all efforts for betterments were distanced by the mighty struggle to save to the people their inheritance, without so much as a thought as to when, where or how intercommunication could be made available for a successful prosecution of the war. Since that time the nation has pressed forward with such gigantic strides, in spite of its internal barrenness, that to-day sees little being done except such city or state enactments as have forced themselves upon willing and unwilling legislative or municipal lawmakers. It really seems improbable in the light of to-day that any betterment of the condition of the people can be successfully inaugurated without a certified number of forceful ballots for the enactors, that they may succeed themselves and thus entail upon us all the evils of continued inaction.

Thus to the states, the cities and the towns we must turn for the proverbial half-loaf. Could it have been possible for politics to have been controlled by such forceful laws as govern the chemical world, we would not, to day, be floundering in the mire of legislative neglect.

EXPERIENCE IN STREET PAVING.

THE following is taken from the report of Mr. Stevenson Towle, consulting engineer of the New York Board of Public Works, on street paving in that city:

"Until within thirty years most of the streets of the city were paved with cobble-stone, which was the cheapest and answered fairly well for light traffic; but as business and commerce increased heavier loads had to be carted, which this pavement was not strong enough to bear. But probably the principle cause that hastened their destruction was the laying of pipes for the introduction of Croton water, which began in 1842, and shortly afterwards for sewers.

"So general was this tearing up that no amount of repairs was possible to restore them to a passable condition, and New York, as a consequence, became noted for its poor pavements, which must continue so long as private corporations, receiving their authority from the state and independent of the full supervision of the city authorities, can tear up at will pavements (even new ones), as soon as laid.

"The constantly increasing commerce requiring the transportation of heavy loads made it necessary to replace the cobble by a substantial and smoother pavement, and one that would allow the increased loads to be handled without much additional labor. Various kinds of pavements were tried, notably the Russ patent pavement, laid on Broadway, south of Fourteenth street, in 1849.

"This pavement was the most substantial and durable pavement that could be devised; formed of blocks of syenite or trap-rock, from eight to twelve inches wide, laid in diagonal courses on a substantial concrete foundation. Notwithstanding its great cost and durability it was not satisfactory; it wore extremely smooth and at last became so slippery from the size of the blocks, and close fitting joints that it had to be removed (about 1869), even after close channels or grooves had been cut to increase footholds of horses.

"The Belgian pavement was first introduced here about the same time as the Russ (first laid in the Bowery in 1852), and immediately became popular, and, for the time being, answered every purpose of a good pavement. It was cheap, durable and easily repaired and cleaned; it soon entirely replaced the cobble to the great satisfaction of the public. This satisfaction it enjoyed for a short period only, for soon a new engine of destruction was brought to bear, and the street railroads proved to be more destructive than the laying of water pipes, sewer and gas-pipes, and the fine pavements that cost so much money were destroyed in laying the many railroads. By reducing the available traveling surface to the extent of the space occupied by the tracks, the whole vehicle traffic was thrown on the remaining pavement, which added greatly to its wear and hastened its destruction. As traffic increased even this good pavement was no longer of sufficient durability; a stronger pavement had to be provided, capable of bearing the heaviest loads.

"The commercial cities of Europe, London especially, were also experiencing the necessity of providing stronger pavements to meet the increasing needs of heavy traffic. Large sums of money were being spent in experimenting to obtain the best; careful observations were made of the different kinds of pavement. London authorities found that the pavement that suited for business streets of heavy traffic was one of granite or syenite (trap), laid on a substantial hydraulic concrete foundation, and that the best form of blocks was three inches in width, from ten to twelve inches in length and a uniform depth of from seven to nine inches. This uniformity in depth was considered as essential to the stability and uniformity of surface; other cities followed the experience of London, excepting slightly varying of the size of blocks.

"This pavement was afterwards introduced in this country and laid on Broadway, south of Fourteenth street, by Charles Guidet, in 1869, replacing the Russ pavement. It was all that could be desired, and remained good with but few repairs for many years, notwithstanding that it was, almost as soon as laid, extensively torn up, first for the Western Union Telegraph Company's pneumatic subway, new gas, steam and water pipes, and last for the surface railroad, which completed its destruction. This satisfactory trial and experience of European cities were evidences of the advantage of this pavement, and it would have continued to be laid had not parties claimed the exclusive right to lay it in this country. Another reason was its great cost, which was due to the want of skill

in quarrymen, who were unused to preparing blocks so near dimension sizes; but as soon as quarries were worked scientifically, and men became skilled in cutting and handling the blocks, this pavement, by omitting the concrete foundation, could be laid as cheaply as any other. Most of the old Belgian pavements on business thoroughfares were replaced by it. It was soon evident that even this pavement was not strong enough for the still increasing weight of loaded vehicles; loads of ten tons were common, and even forty not uncommon. Extraordinary repairs were inadequate to keep them passable, notwithstanding cost and the special appropriation for the renewal of pavements authorized by chapter 321, Consolidation Laws, was sufficient to renew only a small portion of that that was necessary. Better pavements had to be provided, not only for business, but for health and comfort of the residents and public. All interests were suffering; merchants found it difficult to transact business without great loss; many had removed to neighboring cities, and residents were leaving the city and seeking homes elsewhere.

"The necessity for better pavements became so evident that the legislature, at the earnest appeal of Mayor Grant, authorized the expenditure of three millions of dollars for the laying of new pavements. Immediately on its passage you directed me to investigate the improvements that had been made by other cities, and submit plans and specifications for the new pavement.

"A recent personal examination of the principal European cities enables me to submit to you promptly the results of those investigations. London, Paris and Berlin are giving great attention to the improvement of their pavements; vast sums of money are being spent, sums that would seem to our people wasteful and unnecessary. But the importance of good pavements to their prosperity is recognized by all and are had at any cost, no matter how great. In selecting a pavement the wants of the public are carefully considered, and the pavement best suited for the business, for the comfort and health of the public, is selected.

"To within a few years, stone and macadam pavements were general in cities, but now the health and the comfort of the people must be considered, as well as economy and durability. As a result, wood and asphalt are being extensively laid, especially in London, Paris and Berlin, with the most satisfactory results. But few stone pavements are now laid, but when they are, they are constructed in the most substantial manner. Granite is preferred on account of its wearing less smooth than the syenite and other hard rocks. Great attention is being given to the preparation of the foundation, which is either concrete or broken stone or both combined. The blocks are made narrow and give the best foothold for horses, and of uniform depth to give evenness in surface wearing. The best stone pavements in Europe are found in England. London, Liverpool and Manchester have spent vast sums in new pavements, and have to-day the finest stone pavements in Europe.

"In each city the pavements are laid on about the same general plan, and all on a substantial hydraulic concrete foundation. The stone blocks are carefully cut to size, and only one-quarter of an inch variation is allowed from the specified dimensions."

"The width of the block is generally three inches, but varies in length and depth in the different cities. Granite is preferred to the harder stones; while it is less durable, it does not wear so slippery.

"In Liverpool the stone used is syenite or trap; the blocks are quite small and so afford a firm foothold for horses, and are comparatively noiseless.

"In 1872, Liverpool commenced to pave the whole city on an extensive and comprehensive plan. In order to accomplish the best results, the city found it absolutely necessary to purchase the street railroad tracks and reconstruct them in connection with the new pavements.

"Accordingly the city purchased some fifty miles of street railroad tracks and reconstructed them in a most substantial manner, and then rented them to the several original car companies at a fixed percentage of ten per cent. of the cost of construction. I will briefly explain the manner of laying this pavement in Liverpool, which can be taken as a fair example of the practice in other European cities for new first-class pavements.

"The streets are divided into classes according to the traffic and importance. The greatest care is taken to secure a firm foundation of hydraulic concrete from six to twelve inches thick. The blocks are small, of the following dimensions—three inches wide, five to seven inches long, and six or seven inches deep, laid with close joints filled with paving cement (coal tar), and gravel. The blocks are very carefully dressed, and do not vary in width and depth more than a quarter of an inch from the specified size. This uniformity in depth insures a durable, even and comparatively noiseless pavement, and capable of sustaining the heaviest loads. The work is done by day labor, and is costly to lay, but the cost of maintenance is very small.

WOOD PAVEMENTS.

"The failure of wood pavements in this country has not prevented its use in many European cities. It is extensively laid in London and Paris, and replaced fine stone pavements in many of the principal main thoroughfares that are subject to the heaviest traffic. Its success is due to proper and substantial construction and constant care and maintenance. The wood pavements that were laid in this country were constructed in the cheapest manner and allowed to decay. Public opinion in this country is so averse to the use of this pavement that it will be unnecessary for me to give here a detailed description of the manner of laying it abroad.

ASPHALT.

"Asphalt pavements have met with even greater favor than wood. They were first introduced in Paris in 1854, and in London in 1869, and have constantly grown in favor on account of their economy, comfort and for sanitary reasons. A better knowledge of its properties and skill in laying has made it a most desirable pavement. Until recently it was thought that this pavement could not stand severe frost, but it has met with great success in Berlin where it was first laid in 1880, and has withstood the extreme frost of that climate. It is now about the only pavement being laid in Berlin.

"The natural bituminous limestone rocks are had so cheaply in Europe that there is no inducement to produce the artificial asphalt pavements, and these are not laid. I examined critically all particulars of the construction of the asphalt pavements laid in London, Paris and Berlin.

"Only a very few of the bituminous rocks are suited for compressed pavements, and the greatest care has to be used in the selection. The rock must contain the bitumen in the proper proportion or the pavement will fail. The best pavements are those laid with the limestone rock from the Sicilian mines at Ragusa; from the Swiss mines at Val-de-Travers; from the French mines at Seyssel. The pavement is always laid on a foundation of concrete from six to twelve inches in thickness. The thickness of the asphalt is from two to three inches. In all kinds of foreign pavements, whether stone, wood or asphalt, the foundation is considered the pavement proper, and is laid in the most thorough manner, and allowed to dry completely before the pavement is laid.

"The pavement is prepared in the following manner: The rocks are first broken with stone crushers, afterwards crushed between rollers to a fine powder; it is then heated to the required temperature and then carted to the works in carts constructed for the purpose, where it is evenly spread on the concrete foundation in quantity to give the required thickness, then compressed, which is done by heated iron rammers. To insure success every part of the process and preparation of laying must be most skillfully performed. It is found that this success is best secured by a guarantee of maintenance for a period of years.

"The cost of laying pavements in London, Paris and Berlin on a six-inch concrete foundation averages per square yard, for wood, $4; for asphalt, $3.25; for stone, $3.50, exclusive of the cost of maintenance.

"Col. Haywood, engineer of London, in his report January

1882, gives the following valuable information as to the maintenance of pavements:

"'The contracts for asphalt are for a term of seventeen years. For the first two years the pavements are maintained at the cost of the contractor, and for the remaining fifteen at the cost of the city at a contract price per square yard, per annum, measured over the whole surface of the pavements, for which the contractors are bound to keep the pavements in a good state of repair. At the termination of the contracts the pavements to be left in a good condition to the satisfaction of the engineer. The maintenance of wood pavements are on the same condition.'

"As almost every main thoroughfare in the city has now for years been paved with asphalt or wood, to estimate a comparison of cost of maintenance of granite, wood and asphalt, Mr. Haywood estimates the cost of repairs of certain main thoroughfares which were made when they were paved with granite and just before wood and asphalt were introduced.

"It will be seen from this report that the average annual cost of maintaining 16 Vol-de-Travers compressed asphalt was 24 cents per yard; of 7 Limmer asphalt compressed, 19 cents per yard; of 5 syenite Fransais des asphaltes compressed asphalt (Seyssel Rock), 22 cents; 27 wood pavements, 26 cents per square yard; and of 5 granite blocks, 11 cents per square yard.

"The experience of Paris as to the comparative cost of maintenance is about the same as London, but the cost is almost double, 50 cents for wood and 40 cents for asphalt, while in Berlin, for some reason, the cost of maintenance is much less, probably from the pavements being new and of the most approved manufacture.

"Ten cents is about the average cost for maintenance per yard per year in Berlin.

"The cost of maintenance of macadam pavements laid in these cities is much greater than any other pavements, being from twenty-five to fifty cents per yard per annum. This pavement in city streets is generally being taken up and replaced with asphalt or wood. These prices do not include the cost of restoring the pavements when opened for the purpose of laying pipes, subways or other purposes, which expense is borne by the city's workmen and the expense charged against the companies or individuals. This is the practice even when extensive subways and like work are done by private companies.

"To avoid the tearing up of pavements, tunnels or subways are being built in many of the principal streets of London, and the great main sewers of Paris utilized for the accommodation of water, gas, and all other conduits; these subways prove a great help in preserving the pavements, and their cost is soon repaid by the saving in cost of maintenance, besides the advantage of always having good pavements.

"This proper restoring of the pavements when opened for any purpose is deemed a vital necessity, and the most rigid laws and rules must be everywhere observed. Good pavements can not be had without such rules. The excellent pavements of Europe are due to the manner in which this work is performed; the result is, that pavements are seldom taken up, and when it is necessary to do so they are properly restored. The same stringent rules apply to the street railroads, the manner of laying which is vastly superior to the practice in America. The grooved rail is universally adopted, laid on substantial metal stringers and sleepers, resting on a concrete foundation; wood is not allowed in the construction.

"Liverpool has some fifty miles of such railroad tracks, which are owned by the city and rented to the several companies. With tracks constructed in this way few repairs are required, either for the structure or the pavements adjoining.

"In all cities street-car tracks are considered part of the pavement of the street, and as they are constructed offer no obstruction to travel; vehicles pass over them without hindrance or danger. A good pavement is the first consideration, and street railroads are constructed with this always in view. The grooved rail is always used, even in Berlin and the more northern cities of Europe, where frosts and snows are as severe as in New York.

"Every means is taken to preserve the pavement, even to the shoeing of the horses. It is the common practice and law that shoes shall be smooth; toe and cork are nowhere allowed. This is a very ancient custom, and originated in the necessity of preventing injury to roads and pavements that follows the use of sharp toes and corks. The difficulty and cost of maintaining pavements in this country is due, in a measure, to our way of shoeing, and the uneven wear of pavements is due as much from the striking of the horses' shoes as from the wheels, and where the horse is shod with toes and corks the stone blocks are worn round and uneven and the macadam picked to pieces."

[To be continued.]

WATER MAINS AND SEWERS AT PROVIDENCE, R. I.

THE last annual report of the city engineer of Providence, R. I., gives some figures regarding the cost of laying water mains and constructing sewers. The approximate cost per foot of water mains and laying same, including all appurtenances except hydrants, and allowing $30 per long ton for the pipe, is given as follows:

Size, ins.	Cost.	Size, ins.	Cost.
4	$0.498	16	$2.403
6	0.725	20	3 359
8	0.973	24	4.454
10	1.244	30	6 348
12	1.593	36	8.540

The average contract cost of labor, per foot, on the different sizes of sewers, built in Providence during the last three years, has been as follows:

8 in. pipe in basin connections	$0.63
12 " " sewer	1.20
15 " " "	1.34
16 " single course brick sewer	1.70
18 " " " " "	2.05
20 " " " " "	2.03
22 " " " " "	1 50
24 " " " " "	2 55
48 " double " " "	3.25
20x30 in. single course brick sewer	2.15
22x33 " " " " "	2.60
24x36 " " " " "	2.30
26x39 " double " " "	2.60
28x42 " " " " "	3 00
36x54 " " " " "	2.65
38x57 " " " " "	3.67
40x60 " " " " "	5.47
Rock excavation, per cu. pard	4.00

The average cut for 12- and 15-inch pipe sewers was about 12 feet; for brick sewers, 13 and 15 feet, with the exception of the 40x60-inch sewers, when the average cut was about 24 feet. The excavation was mostly in sand and gravel.

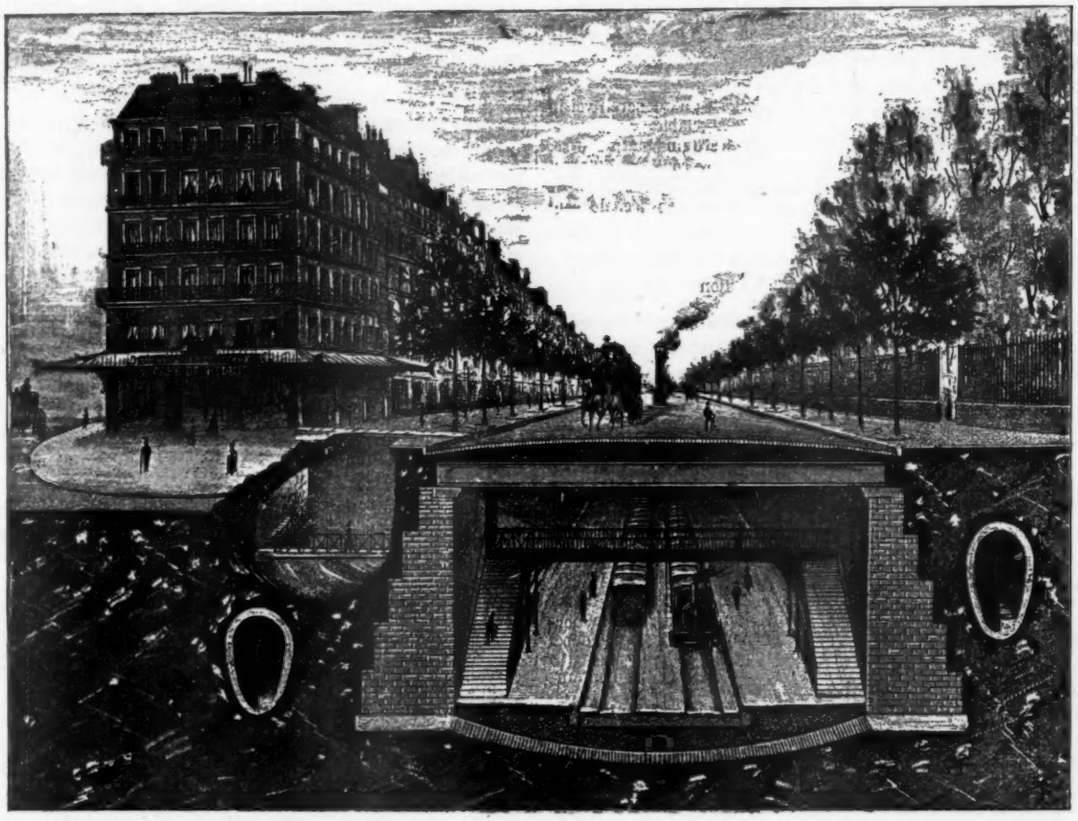
TESTING PAVING STONES.

THE following plan of testing the comparative value of paving-stones is adopted at the Paris Laboratory for Testing Materials: A sample of the rock of regular form is placed upon a horizontal plate, rotating round a vertical and pressed against it by suitable contrivances. The wear is then compared with that of a standard material under the same conditions. The co-efficient of wear is the proportion between the volumes worn, which can be easily ascertained by weighing the specimens, and determining the volume from this weight, and the specific gravity of the material in question. The rotating surface is cast-iron. The two specimens, viz: test piece and standard, are placed at opposite ends of a diameter of the rotating plate, against which they are pressed by equal weights. The standard used is Yvette sandstone, and first-class materials have a co-efficient of from 1 to 1.40, while with second-rate materials the co-efficient is between 1.40 to 2.40; if the wear is greater than that represented by the latter figure, the material is rejected. An additional test is made by placing specimens of the stones to be tested in a cylinder, which, like those used in clearing scrap iron from rust, is mounted and rotates on an axis which does not coincide with its center of figure. The amount of detritus after the material has been treated for a certain time in this machine is compared with that from a standard rock under the same conditions.

THE PARISIAN SUBWAY.

THE Sceaux railroad, built about 1848 on the plans of the Engineer Arnoux, was intended to show the possibility of using curves of very small radius. The principle of the system adopted consisted in the use of guiding rollers or wheels to keep the engines on the track, while the driving wheels had no flanges. Unfortunately this system was somewhat complicated for ordinary use and required a very wide gauge, so that it did not come into general use.

The Orleans Company recently bought this short road, and is now rebuilding it as an ordinary road and supplying it with equipment of the ordinary types. In connection with this rebuilding the road is being extended from the old terminus for some distance into the city. The new terminus is at the Rue Medicis, and the underground line by which that point is reached is to be extended across the city to the Orleans station on the Quai Maubert. The extension from the Rue Medicis is being surveyed.



SUBWAY FOR THE SCEAUX RAILROAD IN PARIS.

With a short addition outside of the city this will make a very convenient loop.

The extension now building is entirely underground. With the exception of a short distance under private property it runs under the street, most of the way under the Boulevard St. Michel. The line is double track, and for most of the distance has a grade of two per cent. Where it is sufficiently below the surface the tunnel is arched over with masonry; at other points there are retaining walls suporting iron girders which carry the street pavement. The latter is the method shown in the accompanying illustration, [from the *Railroad and Engineering Journal*], which is a section through the station at the Rue Medicis, the arrangement of which is very plainly shown. At this point the track is 32.8 feet below the street level.

Ventilation of this subway is provided for by iron shafts or chimneys placed in the center of the boulevard at intervals of 328 feet. Some of these shafts are shown in the cut; in a narrow or crowded street they would have to be differently placed. The station, it will be seen, has stairways leading to a passage under the sidewalk, the ticket-office and waiting-room being in one of the buildings adjoining, so that there is no interference with the street itself. This subway has some points worth consideration here.—*Le Genie Civil.*

CALIFORNIA'S ASPHALT MINE.

By L. Blankenhorn.

THE mines occur in two fields, south and west of Bakersfield, one lying in the foothills on the north side of the Tehachepi, and the other on the eastern slope of the coast range. They have been practically unknown for many years no state mineralogist or geologist, except perhaps Hanks, having mentioned them. Their value, however, was foreseen, and the locations covering the asphalt and oil, they being together, were most of them patented years ago —among others by Solomon Jewett, the millionaire banker, rancher and sheep-raiser, who located a claim in 1861, thirty years ago. The Buena Vista Oil Company spent $25,000 in development, and the Union Oil Company, composed of Georgians, a large sum also; but lack of transportation or high rates and prices made it unprofitable in those times. Since then the investigation of asphalt and its application to paving, roofing, varnish and other uses have brought it into use in the United States to the extent of 70,000 tons annually, with an increase of fifty per cent. last year, practically all of which has heretofore been imported. Its chief use has been for paving, over four hundred miles of it being now laid in a score of cities, including New York, Brooklyn, Philadelphia, Washington, Buffalo, Cincinnati, Detroit, Omaha, St. Louis, on a large scale. It is looked upon as the most desirable pavement from the standpoint of durability, cleanliness, noiselessness and economy ever used by cities, and the demand for it in the immediate future is likely to task the world's sources of supply.

Although asphalt has been found in Utah, Wyoming, Kentucky, and other localities, its development has been hampered by problems of distance, transportation, etc. It is found in various coun-

ties of the state, from Monterey south along the coast range mountains to Los Angeles, but I believe it is reserved for the Kern county fields to show a future production of millions of tons, and a supply second only to the pitch lake of Trinidad.

The two fields mentioned are each about five miles long, and the black surface indications, outcrop and springs in many places still alive are visible for miles when approaching them. The Standard Asphalt Company of Bakersfield, California, now control these asphalt mines, and for several months past have been engaged in refining and shipping it. Some of the men constituting the company, bringing to it the capital and experience necessary to push it, are Solomon Jewett and H. A. Blodget, of Bakersfield; Henry Williams, of San Francisco; E. G. Church, for many years manager and superintendent of the Barber Asphalt Company, at Buffalo, and Kansas City; S. Hutton and myself of this city. Mr. Church, who is an expert and authority on asphalt, and familiar with the Trinidad and others, pronounces the Standard, of Kern county, equal to any produced, if not superior, for paving and kindred purposes. The company have now a force of men and twenty kettles in operation refining the asphalt, which refining capacity will be largely increased by plants now being constructed.

The asphalt occurs in layers and masses at present of unexplored thickness, easily taken out with the pick and wedge. The liquid asphalt, or flux, is added in certain proportions, and melting proceeds until the dross or sand has settled and the pure and refined liquid can be drawn off into boxes and barrels ready for shipment.

SEABOARD ROAD ASSOCIATION.

AN organization to be known as the Seaboard Road Association, having for its object the arousing of public sentiment on the question of improved highways, and the securing of better highway laws. It was agreed that expenditures for improved roads ought to be directed by civil engineers and that the maintenance of the roads should be especially provided for. The association is to be governed by a committee of fifteen which will hold a regular meeting each year on the second Tuesday in September. The following are the members of the governing committee; Jno. Bogart, E. P. North and J. R. Dunn, from New York; E. P. Carpenter, A. A. Pope and A. F. Noyes, from Massachusetts; Jas. Owen and F. A. Dunham, from New Jersey; A. J. Cassatt, from Pennsylvania; C. L. Burdett, from Connecticut, and A. Coleman, from Rhode Island. The other five members are to be elected by those already appointed.

Col. Pope has volunteered a contribution of $1,500 toward the work of the society, and Mr. Dunn stated that the League of American Wheelmen will probably contribute at least $1,000.

BRICK PAVING IN MEMPHIS.

MR. NILES MERIWETHER'S specifications for brick paving in Memphis are as follows: "The roadway between curb lines shall be taken down to sub-grade, care being taken not to plough within three (3) inches of the sub-grade stakes, which last shall be carefully removed with pick and shovel in such a manner as to leave a true and perfect surface, which shall be rolled down with a five-ton roller three times before the concrete foundation is laid. Before the sub-grade foundation is finally fixed, all water and gas pipes must be put in and adjusted; the water pipes must be of lead, double strength, and the gas of the best galvanized pipe; the trenches shall be filled in layers of three inches, and carefully rammed to within six inches of sub-grade, and the balance of trench concreted.

CONCRETE.

"Upon the sub-grade thus formed shall be spread the concrete foundation, composed of hard limestone, broken or crushed, to pass a two-inch ring, the same to be free of all dirt, trash, etc., clean, sharp sand mixed with fine gravel, and the best fresh Louisville cement, in the following proportions, viz.: One measure of cement and two of sand, thoroughly mixed, dry, and then made into mortar, with the least possible amount, and into this will be put the macadam, which shall first be well wet, and the whole worked into a concrete in such quantities as will produce a surplus of free mortar when well rammed. This proportion, when ascertained, will be regulated by measure. Each total of concrete will be thoroughly mixed, in suitable boxes, with hoes and shovels, the mortar always to be mixed fresh before being applied to the broken stone. It will then be spread and at once thoroughly compacted by ramming with heavy cast-iron rammers, until free mortar appears on the surface; the whole operation shall be done as expeditiously as possible. The upper surface will be made exactly parallel with the surface of the pavement, to be laid by floating over the surface with cement and the straight edge. The depth of concrete consolidated, when completed, shall not be less than nine (9) inches. No walking or driving shall be permitted on the concrete when it is setting, and it shall be allowed to set for three (3) days, before any pavement is laid on it.

PAVEMENT.

"On the concrete foundation thus prepared, a bed of clean, sharp sand, free from moisture, two (2) inches deep, shall be laid. The paving bricks to be used shall be such as shall be satisfactory and acceptable to the engineer, and shall conform strictly to the samples offered by the contractor and accepted by the engineer and the council. The sand must be brought to a true and perfect surface and made to conform strictly to the grade pegs set by the engineer, by means of a drag straight-edge, seven (7) feet long, drawn over the surface, and resting on two pieces of scantling 2x4–16 feet long, having planed surfaces. The top surface of the sand bed being flushed with the grade pegs. Upon this bed of sand, the paving bricks are to be laid on edge, at right angles to the line of curbs, in parallel lines, in as close contact as possible on sides and ends; the joints broken one with another, by starting at curb lines with half bricks, in alternate rows, so as to break the joints. No half or broken brick shall be laid except at the curb lines, in order to make closures, but the bricks must be laid whole throughout, except as above named.

"As the pavement is laid over thirty or more feet at a time, it shall be thoroughly rammed over three times with a flat iron rammer, about one foot in diameter, weighing thirty or forty pounds, which must be done by lifting and dropping the rammer vertically. When the bricks have been rammed to a solid bearing and brought to a perfect surface, the interstices shall then be thoroughly and completely filled, from bottom to top, with distilled coal tar pitch (known as No. 6), heated up to 300 degrees. All crevices must be filled, and the entire top surface cover to a depth of not less than one-fourth inch, and upon this must be spread one-fourth inch of clean, sharp sand, which must be comparatively dry and free from moisture. This sand must be thrown evenly over the boiling pitch, as rapidly as the pavement is filled in, and the pitch spread over the surface of the pavement, the aim and object being to make the pavement one solid mass, which, when completed, shall be practically a fixture and water tight. The bricks shall be rigidly inspected before being laid in the pavement, and all objectionable ones removed. The sand and pitch shall be acceptable, and shall also be applied as directed by the engineer, or his assistant, and to his entire satisfaction and acceptance. The pavement, when completed, must be smooth and conform to the grades given by the engineer.

DIMENSIONS OF BRICK.

"Square edged, to-wit: Length, 8¾ inches; width, 4 inches; thickness, 2¾ inches. Hallwood block, patent: Length, 9 inches; width, 4 inches; thickness, 3 inches.

"Bricks thoroughly burned throughout to vitrification."

HIGHWAY IMPROVEMENT IN NEW YORK.

THE State Roads bill has been defeated in the New York Assembly. It provided for the issuance of $10,000,000 in bonds for 3,000 miles of roads, two roads in each county, intersecting at the county seat. Supervisor Dunton, of Jamaica, has obtained the views of some of the citizens, and they are favorable to the bonding the town for $400,000 and macadamizing twenty-eight miles of highways. It is expected that there will be opposition to this. The surpervisor has had twenty-five miles of road mapped out for improvement at a cost of $300,000. It is proposed to bond the town for $300,000 at four per cent., the bonds to run for twenty years.

NEEDED ROAD LEGISLATION.

MR. H. A. GARFIELD, of Cleveland, in a letter to the editor of PAVING AND MUNICIPAL ENGINEERING, on the subject of needed road legislation, says: "The subject of roads and streets, especially the former, since it has been the most neglected, deserves fullest consideration, and immediate and thorough action. Outside of all questions as to the scope and kind of legislation needed, the handling of this and kindred subjects by our legislation may well encourage our citizens to feel at last the proper kind of questions are being taken up by state governments, and that every step in this direction must tend to dignify our state congresses by giving them responsibilities the meeting of which requires careful study and thoughtful foresight.

"And again, a collateral but perhaps the most important matter involved is the benefit of proper legislation to the farmer. Good roads—that is, not only well built but carefully and continually maintained—will increase the market value of abutting farms, and will connect the harvest-field with the market by shortening the time of transportation, saving many of our horses and enabling the farmer to utilize bad weather, which shuts him off from work on his farm, for getting his products to market. As to the kind and scope of needed legislation, the subject is one which can not be fairly dealt with except at length, for new powers suggest new dangers if not properly limited—the distinguishing point, by the way, between revolution and reform. However, this much may be said, that in general, country roads must be properly classified, constructed on scientific principles, both in laying out and building; supervised by properly qualified engineers, so appointed that throughout a state there may be unity of action and economy, continually maintained under the general direction of the aforesaid engineers.

"One of the most intricate questions in connection with these legislative questions is that of the taxation or assessment necessary for carrying them out. Personally I am of the opinion that present legislation allowing money tax to be commuted for labor, or providing for labor tax direct, should be abolished; and in general, that the poorer and more remote locations of travel in hilly or mountainous regions, where roads are the worst, should be assisted by the larger political division—the county or state—depending on circumstances in constructing and maintaining its roads."

AN OPINION REGARDING PAVING BRICK.

COMPLAINT is made that many of the brick that are now used for paving are too soft. It appears to us that there is an error in using too large brick for paving purposes. No street in the city has worn equal to the block on Hamilton street, in front of the court-house, that has been down nearly ten years. This was laid with ordinary brick of the common size, and it has stood all the tests that a pavement could be subjected to. It is an impossibility to burn these larger bricks homogeneously, and when the surface is worn off the interior of the brick is softer and wears very rapidly. It is a fact that there is no material for paving like hard brick, but it wants to be hard and well burned. The paving in the upper end of town, particularly on Adams street, is showing signs of wearing away.—*Peoria Journal.*

PARKER'S PATENT CEMENT.

By W. L. S. Bayley, C. E.

THE first use of cement is unknown, but years ago "Parker's Patent Cement" occupied the highest niche in the list of cementing materials, and for this reason we give its chemistry:

23 per cent. Silica,
7 per cent. Aluminum,
12 per cent Oxide of Iron and Mag.,
55 per cent. C. Lime,
3 per cent. Loss.

This formula may have been a secret with Mr. Parker, and possibly he himself could not have explained the cause of its strength; but we, to-day, note full silica, full alumina, and low lime. The hydraulicity of the cement is not found in the silica but in the alumina of the clay.

THE PAVING-BRICK TRADE.

The common council of Sullivan, Ind., have decided to pave a street about a mile in length with brick. There is an immense deposit of clay near Sullivan, and an excellent field is offered for the establishment of a paving brick plant.

The Oil City Brick and Tile Company, Oil City, Pa., has been incorporated. The Grant Works at Two-Mile Run have been bought, and the new company will put in improved machinery for the manufacture of paving and building brick.

The discovery of an inexhaustible bed of the finest kind of fire-brick clay has been made in South Joliet, Ill., on the farm of James Boyd.

A paving-brick factory will shortly be started at Rich Hill, Miss.

The Chenoa Tile Works, Chenoa, Ill., is building a 24x26 foot kiln for James Mullins, E. Palestine, Ohio, and they are turning out the finest kind of vitrified pavers, 99½ per cent. perfect on kiln runs, and weigh between six and seven pounds. They burn 4,000 of them with one ton of soft coal. The Chenoa Tile Works are also building kilns at Otsego, Mich., Bridgeport, Conn., Stamford, Conn., Ottawa, Ill., and Jefferson, Wis. Also, at Boston, Mass., Guthrie Center, Iowa, Farlow, Ill., Nashville, Ill., Milwaukee, Wis., Streator, Ill., and Tacoma, Wash.

The London Clay Company of London Mills, Ill., are receiving calls from Indianapolis, Omaha, Chattanooga, Memphis, and other points south and west for their paving brick. This company has a large capacity, and is turning out one of the best paving bricks in the United States.

PERSONAL.

Mr. C. F. Kohlman, has been unanimously re-elected city engineer of Racine, Wis.

Mr. Thomas Murray has been re-elected city engineer of Davenport, Iowa, which position he has held for twenty-three years.

Edward Armstrong, chief of the department of public works, Allegheny City, Pa., died at that place on the morning of the 2d inst., after an illness of several weeks' duration.

Mr. R. N. Ellis has resigned his position as city engineer and superintendent of water-works at Jacksonville, Fla., and has accepted the position of general manager of the National Peace River Phosphate Company, with offices at Jacksonville, Fla.

Improvement and Contracting News.

PAVING.

Clearfield, Pa., wants paved streets.

Lebanon, Ill, wants macadamized streets.

Bedford, Iowa, proposes to have paved streets.

Salem, Oregon, will pave nine blocks of her streets.

Salem, Ore., will pave a number of streets this season.

Eugene, Ore., will expend $10,000 on street work.

Boone, Ia., is thinking of paving several streets with brick.

Davenport, Ia., will pave two miles of her streets this season.

Saginaw, Mich., will spend $100,000 for paving this year.

Ashland, Wis., will pave several streets with cedar blocks.

Keokuk, Ia., streets will be paved with brick this summer.

The question of paving is under discussion at Butte, Mont.

Park Manor residents, Chicago, Ill., want macadamized streets.

St. Louis, Wis., wants a number of streets paved with fire brick.

It is proposed to boulevard Sandusky street, Bellefontaine, O.

Vermont avenue, Toledo, O., is being paved with cedar blocks.

Alliance, O., proposes to spend $20,000 for street improvements.

Indianapolis, Ind., will spend $100,000 on her streets this spring.

Des Moines, Ia., will do about six miles of paving in a very short time.

St. Joseph, Mo., will pave a number of streets during the coming season.

Butler, Pa., is considering the question of paving her streets this summer.

Forty thousand square yards of brick paving are to be laid in Rockford, Ill.

Pottawatomie street property owners, Kansas City, Mo., are talking of paving.

Over $50,000 of city improvements have been started this spring at Dubuque, Ia.

A quantity of street building will be done in South Kokomo, Ind., this season.

The citizens of Niles, Mich., are agitating the question of Portland cement sidewalks.

Elmshurst, Ill., will pave two miles of street; estimated cost of the work is $30,000.

Belgian block pavements are to be put down at Staunton, Va., at a cost of $22,000.

Over $50,000 worth of street improvement work has been started at Dubuque, Iowa.

The electric street railway company, Keokuk, Iowa, is in favor of paving Main street with brick.

Sioux City, Iowa, has authorized for bids for thirty days for a street sweeper. Address the city clerk.

Richmond, Va., has appropriated $85,000 for street improvements equally among the six wards of the city.

Ft. Madison, Ia., will pave several streets this season, and will also construct several blocks of sewerage.

Cincinnati, O., contemplates spending one million dollars on her streets during the coming summer.

The board of public works, Indianapolis, Ind., has decided that it will not have macadam streets at all.

It is altogether probable that a large amount of street paving will be done at Aurora, Ill., this season.

The board of public works, Nashville, Tenn., have ordered that Douglas avenue be paved and macadamized.

Lawrence county, Ohio, has voted to issue $150,000 for a turnpike system. The surveys are now in progress.

St. Louis, Mo., is considering the advisability of paving Easton avenue as far west as Taylor avenue with granite.

Danville, Ill., will lay a large amount of brick paving, and the city clerk has been directed to advertise for proposals.

A large number of streets and sidewalks will be repaved and macadamized during the coming season at Salt Lake City.

Grading has been commenced on several streets at Toledo, O., preparatory to laying fire brick and cedar block pavements.

It is understood that contracts at Columbus, O., have been let for eighteen miles of brick streets to be put down this year.

Butte City, Mont., proposes to pave several of her principal streets as soon as satisfactory arrangements, plans, etc., can be made.

The city council at Yankton, Neb., has ordered the construction of a large amount of cement sidewalks and macadamized streets.

Kansas City, Mo., proposes to macadamize three of her principal streets; also to grade Summit avenue to twenty-ninth to thirtieth.

Richmond, Va., has appropriated $85,000 for street improvement, to be divided among the six wards according to the taxes paid the city.

Sealed proposals will be received by the city council at Avondale, O., until May 25, for the paving of Maine avenue with hard-burned or vitrified brick.

The board of public works at Duluth has prepared its final report on the paving of West Fifth street. The cost of paving is $23,171.80, of which the city pays $3,001.80.

A petition is being circulated through Harrison county, W. Va., asking the court to submit to a vote of the people the levying of a tax to macadamize the roads of the county.

The property owners on Sixth street, between Pearl and Water streets, Sioux City, Iowa, presented a petition to have that street paved with brick, instead of cedar blocks.

At the final meeting of the finance and street committees and representatives of the Barber Asphalt Company at Louisville, Ky., the claim of the company for the repair of Third street, amounting to $45,096.76, was allowed.

The ordinance for the paving of Moss avenue has been published, and the petition for the assessment of special tax will be filed in the county court, Peoria, Ill., at an early date.

Ten thousand dollars has been appropriated to be expended on the improvement of Market street, Wilmington, N. C. The idea is to macadamize as far as the appropriation will admit.

Sealed proposals will be received at Toledo, Ohio, for the paving of Oliver street with either Trinidad asphalt, cedar blocks, or vitrified fire brick. Bids will be received until the 25th of May.

The board of public works, Denver, Col., has directed its engineer to prepare estimates for the paving of Seventeenth and Eighteenth streets with asphalt. As soon as this work is done bids will be advertised for.

The bids for paving Front street, Toledo, O., were again rejected, and the city clerk authorized to re-advertise. The reason given for rejecting the bids was that they were $15,000 higher than the previous ones.

The paving of Whiteside street, Chattanooga, Tenn., is being pushed with commendable energy. George L. Gillespie is doing the concrete work, and the Southern Paving Company is laying the block asphalt.

The superintendent of streets has estimated that $130,000 would cover the cost of replacing the cobbles in the business portion of San Francisco with basalt blocks. He strongly recommends the expenditure of that amount for that purpose.

Jefferson Park, Peoria, Ill., has been repaired by the water company as far down as the court-house square. The planks that form a basis for the cedar blocks are all new, and many of the blocks are new. It will be the best part of the street when completed.

The board of public works, Indianapolis, Ind., will advertise soon for bids to improve Virginia avenue, Kentucky avenue, North Delaware street, Massachusetts avenue, St. Clair and Seventh streets. Most of them are to be paved with asphalt, and at least one with brick.

Bids will be received by the city clerk of Mattoon, Coles county, Ill., until 1st of June for paving Broadway with brick. A sufficient bond will be required for the performance of the contract, and a sample of the brick or other material must accompany the bid.

The Union county court has made an appropriation to build a wagon road down Sine creek, in the eastern part of the county. This will complete a first-class road from Union to Helena, the seat of the Seven Devils mines in Idaho, and make Union the nearest railway point to these mines.

City Engineer Mansfield, Indianapolis, Ind., has submitted to the board of public works a statement of the cost of improving with brick and asphalt the streets and avenues which the board has decided to improve this year. There will be in all seven streets improved; the total estimated cost is $237,904.40. The city's portion of the cost is $193,432.40.

Bids will be received by the board of West Chicago, Ill., park commissioners at their office in Union park, up to May 26, 1891, for furnishing all material and doing all work required in the boulevard improvement of Humbolt boulevard to Western avenue. For stone curbing, cedar block paving, and granolithic sidewalk.

The Barber Asphalt Company is rapidly securing the desired petitions for asphalt pavements along the principal streets of Denver, Colo. Work on Fifteenth and Sixteenth streets has already begun, and will be pushed as speedily as possible. The company expect to be able to finish all their contracts before the close of the season.

Nearly all the granite works at Lithonia, Ga., as far as *paving cutting* is concerned, remain shut down. The contractors, as yet, have not signed the bill of prices submitted by the Paving Cutters' Union. The negro quarrymen and drillers have also a strong union and have raised their prices, and the contractors have not only refused to sign it, but, it is understood, have sent north and west for white labor to supply their places. They have also ordered steam drills, which will save much labor. The prospect for a vast amount of work is good.

SEWERS.

Eugene, Ore., wants a system of sewerage.

There is a demand for sewers at Butler, Ohio.

Knoxville, Tenn., wants a new system of sewerage.

Butler, O., has adopted plans for a system of sewerage.

The subject of sewerage is being discussed at Hamilton, O.

Ironton, Ohio, has voted to issue $50,000 for street and sewerage work.

John Hunkle, Newark, N. J., invites bids for constructing sundry sewers.

Salem, Ohio, has finally concluded not to build the $100,000 sewer this year.

The question of a new sewerage system is being agitated in San Francisco, Cal.

The city council, Baltimore, Md., has appropriated $216,000 for sewer construction.

The city council at Lawrence, Mass., has been petitioned for sewers in various streets.

Richmond, Va., proposes to spend the sum of $30,000 for sewers during the coming season.

The city council has been petitioned for a sewer in Van Courtland Park avenue, Yonkers, N. Y.

Buffalo, N. Y., is preparing for work on her sewers, and proposals will be advertised for very soon.

The council at Princeton, N. J., has voted to establish a sewerage system there at an expense of $30,000.

The sewer commissioners at New Utrecht, N. Y., invite bids for constructing lateral sewers there.

Mr. Dewing, of San Pablo, Cal., is building a sewer from San Pablo avenue to the bay. He is connecting it with the creek about 100 feet to the north.

At Hastings, Neb., sewer bonds to the amount of $15,000 have been registered by the secretary of state.

Ordinances have passed council providing for the construction of several sewers at an aggregate cost of $7,000.

The Meridian, Miss., city boards took steps not long since for a $10,000 sewer system, to be owned by that city.

Mary Verdon, Oakland, Cal., has petitioned for a sewer on twenty-fourth street, from Market to Myrtle streets.

The board of public works, Indianapolis, Ind., have been petitioned for a sewer on Mississippi from Pratt to 7th street.

The city engineer, New Haven, Ct., has been directed to advertise for bids for the construction of sewers in numerous streets.

The board of public works, Denver, Col., invites bids for the sewers in Delgany street. Bids will be received until May 26, 1891.

The trustees of South Orange, N. J., have passed an ordinance providing for the construction of a sewerage system at a cost of $60,000.

The city clerk at Spokane Falls, Wash., has been instructed to advertise for bids for constructing the Howard and Sprague street sewer.

The Whatcom, Wash., city council is agitating the question of expending $200,000 in extending the limits and constructing a sewer system.

The contract for constructing the southside sewer system, Highland Park, Ill., has been awarded to McDougal & Hammond, of Evanston, for $20,970.

The city council at New Bedford, Mass., has adopted an order for making an appropriation of $50,000 for the construction of a sewer in Sawyer street.

Red Wing, Minn., wishes it to be understood that the effort to secure the establishment of sewer pipe works at that place is not abandoned, by any means, as some rumors would have it.

City council at Cincinnati, O., has been petitioned for the building of a trunk sewer from the Ohio river to 12th street, bonds of which to the amount of $125,000 will have to be issued to run forty years.

WATER-WORKS.

Eaton, Ohio, has decided to have waterworks.

Eastland, Texas, wants a system of waterworks.

Cresco, Ia., wants a system of waterworks.

Rossville, Ill., wants a system of waterworks.

Evergreen, Ala., will prcbably erect water-works.

Marshfield, Wis., wants a system of water-works.

Evergreen, Ala., will probably erect water-works.

East Grand Forks, Dak., wants a waterworks system.

Ogden, Utah, is negotiating for a system of water-works.

Mayville, N. Y., is agitating the waterworks question.

Artesian water-works will be erected at Channing, Texas.

Eastland, Texas, wants a system of waterworks of her own.

Delphi, Ind., wants a system of waterworks this spring.

Kansas City, Mo., wants an entire new system of water-works.

Holland, Mich., has decided to invest $17,000 in water-works.

Schenectady, N. Y., will issue $315,000 in bonds for a new water supply.

Hancock, Mich., will vote a loan of $50,000 to improve its water system.

A system of water-works to cost $50,000 will be established at Newman, Ga.

The question of water-works system is being agitated at McMinnville, Tenn.

De Ruyter, Pa., is taking steps to have a water-works system established there.

Georgetown, Colo., wants water-works. The question will be voted on at once.

Stansberry, Mo., has voted in favor of issuing $15,000 bonds to build water-works.

The Cataract Construction Company will erect a water-works plant at Niagara Falls, N. Y.

The city of Aberdeen, Wash., has advertised for the construction of a water-works system.

The capacity of the Keokuk, Ia., waterworks is being increased 500,000 gallons per day.

Peabody, Mass., has appropriated $4,000 for the extension of the water-pipes to Mt. Pleasant.

Manchester, Mass., has voted to appropriate $125,000 for the erection of a waterworks plant.

The sum of $80,000 has been subscribed for a citizens' water-works company at Tacoma, Wash.

O'Brien & Clark have surrendered their contract for building the $350,000 reservoir at Buffalo, N. Y.

The latest regarding the water question in Butte, Mont., is that there will be two rivals in the field.

North Easton, Mass., has been authorized to increase its water bonds from $75,000 to $90,000 if the people so vote.

Channing, Texas, will begin work on as fine a system of water-works as any town in the panhandle can boast.

At a special election in Ponca, Neb., it was decided by a majority of fifteen that the town should have water-works.

Kansas City, Mo., has appropriated $2,000,000 in city bonds for the building of water-works to be owned by the city.

Union City, Texas, is agitating the question of water-works. It is thought they will issue bonds to the amount of $60,000.

The judiciary committee, Providence, R. I., has reported a bill authorizing the city to borrow $500,000 for water-works purposes.

The city engineer, Lincoln, Neb., is instructed to advertise for the erection of a water system guaranteeing 5,000,000 gallons of water per day for five years. The bidder shall furnish plans and specifications. Communications will be received on or before May 21.

City Engineer Dobson, at Lincoln, Neb., has been instructed to advertise for the erection of a water-works system guaranteeing 5,000,000 gallons per day for five years.

Elyria, Ohio, has granted a franchise to furnish that city with water for a period of twenty years, to capitalists from Cleveland and other cities. They propose to procure the water by a system of drive wells.

Sealed proposals will be received by the board of water commissioners of Dalles City, Ore., until 2 P. M. Saturday, May 23, for building a receiving basin to hold about 370,000 gallons, about four miles from Dalles City.

A. West, of Elgin, Ill., has been engaged to draw plans and specifications for the Manson, Ia., water-works, with the understanding that if his company gets the job of furnishing the system and putting it in he is to make the plans for nothing.

BRIDGES.

Winona, Wis., wants a bridge.

A new bridge will be built at Havana, Ill.

Turner Village, Me., has voted to build an iron bridge.

A bridge will be constructed over the river at Tioga, Pa.

Keedsville, Md., wants a bridge over the river at that place.

A bridge across Wolf creek, Dayton, O., is being discussed.

The Illinois Central road will construct a bridge at Onawa, Ia.

Canton, Mass., has appropriated $6,800 for roads and bridges.

Reading, Mass., has appropriated $4,500, for roads and bridges.

Dartmouth, Mass., has appropriated $3,000 for roads and bridges.

An iron bridge will be erected at Keyport, N. J., to cost $12,000.

It is proposed to build a bridge over the Allegheny river at Warren, Pa.

A bridge connecting West Superior with Duluth, Minn., is badly needed.

The new Mason street bridge, Oshkosh, Wis., will cost no less than $25,000.

A bill before the legislature appropriates $4,000 for a bridge at Catskill, N. Y.

Milwaukee is agitating the question of new bridges over the Wisconsin river.

The public bridge over the Sweedsford road has collapsed at West Chester, Pa.

The pontoon bridge at Dardanelle, Ark., valued at $15,000, has been washed away.

The three bridge propositions were carried by a large majority at Great Falls, Montana.

The Governor has signed a bill appropriating $14,000 for a canal bridge at West Troy, N. Y.

There is a movement on foot to erect a bridge over the Spicket river, at Lawrence, Mass.

Bids for the construction of the three new bridges at Hale's slough, on the Prairieton road, near Youngstown, O., were opened, and the Pittsburgh Bridge Company had the lowest bid and will probably be awarded the contract.

The new Mason street bridge across the Fox river at Green Bay will cost not less than $25,000.

Keokuk, Ia., is agitating the question of building a highway bridge across the river at that place.

The county commissioners at Bozeman, Mont., will build two new bridges on the West Gallatin.

Dearborn, Mich., has voted to build a $3,000 iron bridge across the south fork of the river Rouge.

Pueblo, Col., has decided to build a viaduct across the railroad track on Main street, to cost $18,000.

Boise City, Idaho, wants a good iron bridge across Snake river at the point known as Walters Ferry.

Winchester, Mass., has voted to appropriate $5,000 to build a bridge over the reservoir at Turkey Swamp.

The business men of Green Bay, Wis., are in favor of raising $15,000 to be expended on the Mason bridge.

The proposition to build a $15,000 market bridge across the river at Grand Rapids, Mich., has been defeated.

Citizens of Dearborn, Mich., have voted $3,000 to build an iron bridge across the south fork of the river Rouge.

Greensboro, N. C., proposes to build a bridge across North Buffalo, at the present extremity of North Elm street.

The county commissioners have decided to erect a $60,000 overhead bridge in the eastern part of Youngstown, Ohio.

A bill authorizing Springfield, Ohio, to issue $60,000 worth of water-works extension and bridge bonds, has passed.

The council at Wilkesbarre, Pa., will be petitioned for an iron bridge to connect the north and south side of the creek.

Bertram, Ia., is to have a $3,500 bridge; Coggan a $1,750 structure, and Beverly, over Prairie creek, a bridge to cost $1,600.

The town board at Herkimer, N. Y., is considering a proposition to build an iron bridge in place of the one carried away by flood.

The San Francisco Bridge Company will build a bridge across the Spokane river for the Spokane Street Railway Company, to cost $6,000.

The Lane Bridge and Iron Co., of Chicago, has received a contract at $14,759 for the construction of a bridge over Trinity river at Ft. Worth, Texas.

There is a prospect of the Milwaukee Bridge and Iron Works being taken out of the hands of the assignee and re-established on a sound financial basis within a short time.

A new bridge is wanted over Alum creek at Clifton avenue, Columbus, O., and for this purpose a bill authorizing the commissioners of Franklin county to issue $50,000 in bonds has been passed in the senate.

The secretary of war has approved the report of the board of engineers on the construction of the bridge authorized across the North river to Hoboken, N. J. The act provides that the bridge shall be at least as high as the Brooklyn bridge (135 feet). The proposed bridge will be one of the largest in the world. It will contain ten steam railroad tracks and four surface road tracks, besides foot passage ways.

STREET LIGHTING.

Center Falls, R. I., wants electric lights.

Gilroy, Cal., will be lighted by electricity.

Broken Bow, Neb., wants an electric light plant.

Marion, Ind., is figuring on an electric light plant.

An electric light plant is wanted at St. Ignace, Mich.

Vallejo, Cal., proposes to have thirty-six electric lights.

There is talk of lighting Cedarburg, Wis., by electricity.

There is talk of getting an electric light plant at Ithaca, Mich.

Rockport, Mo., will secure an electric light plant to cost $8,000.

The question of more light is being discussed at Wapello, Iowa.

Arcola, Ill., is considering the question of putting in an electric light.

The town of Penacock, N. H., is agitating the question of electric lights.

Oneonta, N. Y., has voted in favor of lighting the town with electricity.

An effort is being made to establish an electric light plant at Roseland, Ill.

Brockton, Mass., has appropriated $15,000 for lighting the streets by electricity.

Mt. Carmel, Ill., has contracted for 2,000 candle power lights at a cost of $60 a year.

An electric light and power company is being organized at Amboy, Ill., with $12,000 capital.

It is probable that a system of electric lights will be introduced at Central Falls, Rhode Island.

The Oil City Electric Light Company, Oil City, Pa., has been incorporated with a capital of $150,000.

Livermore, Cal., will receive bids for lighting the streets for five years either by electricity or by gas.

An election will be held at Camden, N. Y., to vote on a proposition to light the streets by electricity.

The contract for lighting the streets at Attleboro, Mass., expired in March, and has not been renewed.

The Montauk Electric Light Company, Brooklyn, N. Y., has been incorporated with a capital of $50,000.

An electric light company has been organized at Rome, N. Y., to erect an electric light plant; capital, $10,000.

The contract for lighting the streets of East Orange, N. J., with gas expires May 31, and there is talk of substituting electric lights.

Committee on street lighting at West Rutland, Vt., has been authorized to make a five years contract with some company for lighting the streets with electricity.

The electric light plant at Fort Worth, Tex., is now completed and the claim is made that Fort Worth is the best lighted city in Texas. The plan is perfect. It is stated that there will be additions made to the number of incandescent lights. The company that built the works proposes to operate it 90 days before the city accepts it

STREET RAILWAYS.

Canton, Ohio, will build an electric railroad.

Paris, Ill., is to have an electric street car line.

Mason City, Iowa, is prospecting for an electric line.

An electric railway is to be constructed at Ottawa, Can.

There is a demand for a street car extension at Terre Haute, Ind.

An electric railway will be built from Garrettsville, to Hiram, Ohio.

Beeville, Texas, is agitating the question of street electric railways.

A contract has been signed for the building of a street railway at Carlotteville, Va.

Electricity will be adopted as the motive power on the belt line at Bristol, Tenn.

Beatrice, Neb., will soon be connected with the Chautauqua grounds by an electric railway.

There is talk of an electric railway being extended from Youngstown to the village of Poland, O.

Work on the electric street railway between Waterloo, and Cedar Falls, Iowa, will begin at once.

Lanesboro, Mass., has voted to subscribe $5,000 to aid in the construction of an electric street railway.

About three miles of new road for the electric railway will be built at Champaign, Ill., this summer.

Denver, Col., parties contemplate putting in an electric street car line between the two principal springs.

The city council of Du Bois, Iowa, has granted a franchise for an electric street railway to be completed by September 14.

A street car company has been organized at Harvey, Ill., with a capital of $150,000, and propose building a line two and a-half miles long.

A line connecting Milwaukee, Wis., with Wauwatosa is to be built, Capt. Pabst being the interested party. Steam motors will probably be used.

The American Permanent Way Company has been incorporated by James Coleman Drayton. Col. Alfred Wagstaff, John McLean Nash, Henry Gribble and Theodore Graham Gribble. One of the objects of the company is to work the various patents granted to T. G. Gribble, for street railways, steam railways and subway construction, two of which patents formed the subject of discussion at the ordinary meetings of the American Society of Engineers, Dec. 18 and Jan. 7.

A VALUABLE BOOK.

"DURABILITY OF BRICK PAVEMENTS," by Prof. Ira O. Baker. T. A. Randall & Co., Publishers, Indianapolis, Ind. Price 25 cents.

The subject of street paving is a very important one which has not heretofore received the attention its importance deserves. The above publication is timely and will prove of special interest to Engineers, as it gives in a terse, yet comprehensive manner, the results of experimental tests made by the author, for the purpose of determining the relative value of paving brick as compared with stone, wood, and other paving materials.

The results, as shown in this little book, are suprisingly favorable to brick, and it will doubtless be accepted as a text-book by all interested in that line. The high standing and reputation of Prof. Baker, the author, as a civil engineer is ample evidence that the comparisons and statements are reliable and authentic.

"BIG 4" ROUTE.

NATIONAL UNION CONFERENCE

At Cincinnati, May 18th and 19th. One fare for the round trip; tickets good going May 18th and 19th, returning until the 22d inclusive.

The "Big 4" is the direct route to Cincinnati, landing passengers in the heart of the city; five passenger trains per day.

GERMAN ORPHAN HOME ASSOCIATION ANNUAL EXCURSION

To Cincinnati, via the "Big 4" route, Saturday and Sunday, May 23d and 24th, 1891. $2.50 for the round trip.

The annual festival of the Cincinnati Orphans' Home takes place at Inwood Park, Sunday, May 24th; all excursionists are invited to attend. Excursion tickets good going on all "Big 4" regular passenger trains of Saturday, the 23d, and the two regular morning passenger trains on Sunday, the 24th; all good to return up to and including Tuesday the 26th inst.

Tickets will be placed in the hands of the committee, viz.: Henry Russe, No. 25 North Tennessee street; William Rathert, No. 399 South Meridian street; J. P. C. Meyer, No. 86 North Illinois street; Joseph H. Schaub, No. 88 East Washington street.

YOU WILL MAKE NO MISTAKE

IF YOU CONTEMPLATE A TRIP TO

Chicago, Milwaukee, St. Paul, Minneapolis, or any Northwestern Point,

By purchasing your tickets over the

MONON * ROUTE

L. N. A. & C. R'Y.

The New Management having entirely rebuilt the line, putting in over 300,000 new ties, miles of new steel, new iron bridges, etc., etc. This, in connection with elegant **Pullman Perfected Safety Vestibule Trains,** composed of DAY COACHES, PARLOR and DINING CARS (the only line running Dining Cars between Indianapolis and Chicago), and Pullman Buffett Sleepers, makes this

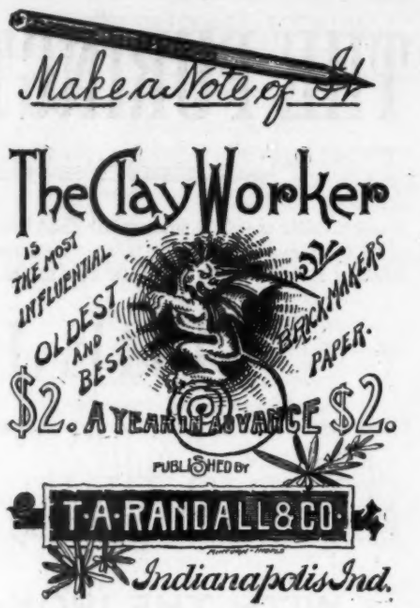
THE LINE between Indianapolis and Chicago, also the Short Line, only 183 Miles Indianapolis to Chicago.

Be sure and purchase your tickets via the

GREAT MONON ROUTE.

Ticket Offices, 26 South Illinois Street, Massachusetts Avenue and Union Station.

JAMES BARKER, G. P. A., Chicago.
I. D. BALDWIN, D. P. A., Indianapolis



* * Send for Sample Copy. * * * *

ALSO PUBLISHERS OF

Tables of Analyses of Clay—A. Crossley. Cloth, $1.00.
Brickmaking and Burning—J. W. Crary. Cloth, $2.50.
Brickmakers Manual—R. B. Morrison. Cloth, $3.00.
Sent postage free on receipt of price.

The Finest on Earth.

The only Pullman Perfected Safety Vestibule Train Service with Dining Car, between **Chicago, Indianapolis and Cincinnati.** The Favorite and Only Line with Through Dining Car **St. Louis to Cincinnati.** The Only Through Car Line between Keokuk, Springfield, Decatur and Cincinnati. Pullman Sleepers on Night Trains and Parlor and Chair Cars on Day Trains between points mentioned. Direct connections without Transfer, in Cincinnati for points in Kentucky, Tennessee, Florida and the Southeast. Washington, Baltimore, Philadelphia, New York and Points East. The best line to Hamilton, Dayton, Lima, Findley, Toledo, Detroit and the Lakes. See that your ticket reads via **C. H. & D.** on sale everywhere.

H. J. RHEIN, Gen'l Agent
C. H. ADAM, City Ticket Agent.
Ticket Office Corner Illinois St., and Kentucky Ave. Telephone No. 737. Indianapolis, Ind.
M. D. WOODFORD, President, Cincinnati, O.
E. O. MCCORMICK, G. P. and T. A., Cincinnati, O.

THE PURINGTON PAVING BRICK COMPANY

OF GALESBURG, ILLINOIS,

Is now building one of the most extensive and best equipped plants ever established for the manufacture of Paving Brick. D. V. Purington, of Chicago, is President of the Company. Mr. Purington is one of the foremost Brick Makers in the country. With a quarter of a century experience he has a thorough knowledge of the merits of the various DRYERS. HE HAS SELECTED FOR HIS NEW WORKS

* * * THE IRON-CLAD DRYER * * *

This Dryer will have a Drying Capacity of SEVENTY-FIVE THOUSAND per day. Mr. Purington's selection is another evidence of the established fact that for

PAVING BRICK NO OTHER DRYER COMPARES

WITH THE IRON-CLAD DRYER

For particulars see advertisement on last page of cover, and write to

358 Dearborn Street Room 304 — Iron Clad Dryer Co. — Chicago Ill.

WORKS; DEARBORN, HARRISON AND 3D AVENUE.

New Discovery
DOWN DRAFT KILN

For uniformity of Burning and Economy of Fuel it is

Not Equaled.

Not Expensive to Build. Easily Kept in Repair.

Those interested, write for many testimonials from the leading plants of the country. Address,

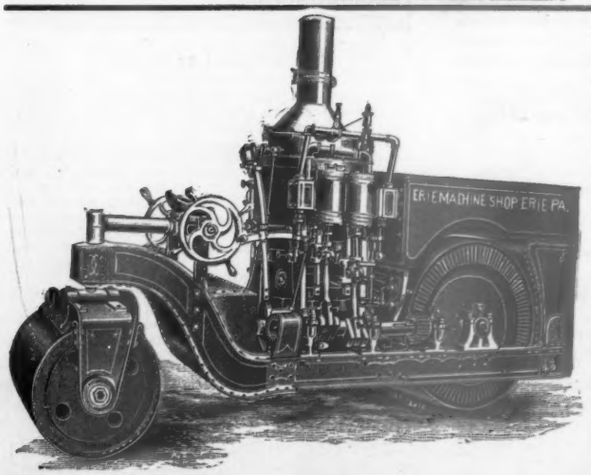
E. M. PIKE & CASTLE,
CHENOA, ILL.

Remington
Standard Typewriter

For Fifteen Years the Standard and to-day the most perfect development of the writing machine, embodying the latest and highest achievements of inventive and mechanical skill. We add to the Remington every improvement that study and capital can secure.

Wyckoff, Seamans & Benedict,
New York.

Indianapolis House, 34 E. Market St.



ERIE MACHINE SHOP,

MANUFACTURERS OF

Steam Rollers

Corner Twelfth and State Streets,

ERIE, PA.

The principal Asphalt Paving Companies in the country are using these machines, which are pronounced to be the best in the market.

PROFESSIONAL CARDS.

The many letters constantly received asking for the names of persons who can give technical advice on municipal work must be answered by the publishers, by referring the writers to this list of competent and reliable Civil Engineers.

ANDREW ROSEWATER, Member Am. Soc. C. E. — FRANK CHRYSLER, C. E.

ROSEWATER & CHRYSLER,
Civil and Sanitary Engineers,
422 and 424 Bee Building, OMAHA, NEB.
Sewerage, Grade Systems, Municipal Public Works.

THOS. R. HASLEY,
CIVIL ENGINEER
Surveys, Plans and Specifications for Sewerage and Drainage, Special Attention paid to Paving and General City Improvement. Expert City Surveying, Detail City Maps, Grade Atlases, Construction Superintended.
Main Office at Marinette, Wisconsin.

Geo. A. Latimer,
City Civil Engineer
Norfolk, Nebraska.
Plain Surveys of Cities and Towns. Designs and estimates for water supply and sewerage systems. Public works superintended.

ARTHUR H. BELL,
CIVIL ENGINEER
DANVILLE, ILLINOIS.
Extensive experience in Brick Paving and Sewerage Work. Surveys, Plans and Specifications and Estimates Furnished.

SAMUEL M. GRAY,
Consulting Engineer
For Municipal and Sanitary Work.
26 Westminster St., Providence, R. I.

H. C. ALEXANDER, Mem. W. Soc. C. E., Mem. Can. Soc. C. E.
FREMONT HILL, Member W. Soc. C. E.
D. C. DUNLAP, Mem. Am. Soc. C. E., Mem. W. Soc. C. E.
ALEXANDER, HILL & DUNLAP,
Civil and Consulting Engineers,
Room 908 Chamber of Commerce Bldg., Chicago.
Railway Surveys, Bridges, Sewerage, Water Supply, Paving and General Municipal Work, Specifications, Plans, Estimates and Reports. Construction Superintended.

W. L. S. BAYLEY, C. E.
Durability, Style and Economy in the Construction of
STREETS, ROADS AND LAWNS.
ESTIMATES AND DESIGNS.
Office, 8 Lakeside Building, Residence, 324 44th Street, • CHICAGO.

S. H. SHEARER,
CIVIL ENGINEER,
Bridges, Sewers, Pavements.
33 Ingalls Block, Indianapolis, Ind.

E. F. LAYMAN,
Civil and Sanitary Engineer,
49 W. 3d St., Cincinnati, Ohio.
Surveys, Plans and Specifications for Sewerage, Drainage and Water Supply. Special attention paid to Pavements and general city and village improvements; also Surveying of city and suburban property.

PROFESSIONAL CARDS.

J. A. STEWART,
EX-CHIEF ENGINEER,
Cincinnati, Ohio,
35 Johnston Building, S. W. cor. 5th and Walnut Sts.
CIVIL ENGINEER,
Surveys and Plans for Sewerage Systems and Street Paving. Railway Surveys. Public Works Superintended.

LATHAM ANDERSON,
M. AM. SOC. C. E.
Consulting Engineer,
Rooms 49 & 54 Johnston Buildings,
Cincinnati, Ohio.
Sewerage, Water Supply, Municipal Engineering, Landscape Engineering, Construction Superintended.

WILLIAMSON & EARL
Civil and Sanitary Engineers.
Plans and Estimates made for Water Supply, Sewerage, Bridges and General Engineering Work, Railroad Surveys and Construction. Construction Superintended. Sewerage a Specialty.
MONTGOMERY, ALA.

CORRESPONDENCE SOLICITED FROM CITIES OR COMPANIES WHO CONTEMPLATE BUILDING OR IMPROVING SYSTEMS OF WATER-WORKS, SEWERAGE OR ELECTRIC LIGHTS.

• • • ◆ • • •

Will make it an object for Superintendents to post me in advance as to contemplated improvements.

• • • ◆ • • •

W. A. CALHOUN, C. E.
Engineering Agent,
GREEN BAY, WIS.
☞ The Securing of Franchises a Specialty.

THE **I. D. & W.** R'Y.
25 Miles ← → The Shortest
ROUTE BETWEEN
Indianapolis and Kansas City
The only line running Reclining Chair Cars between Cincinnati and Keokuk, Ia., without change, via C., H. & D. and Wabash Railways, passing through Indianapolis, Ind., Decatur, Springfield and Jacksonville, Ills. Two daily through trains with perfect connections East and West.
JNO. S. LAZARUS,
Gen'l Frt. and Tkt. Agent
INDIANAPOLIS, IND.

PROFESSIONAL CARDS.

M. AM. SOC. C. E. — M. AM. SOC. M. E.
OLIN H. LANDRETH,
NASHVILLE, TENN.
Consulting Engineer.
Water-works, water power, drainage, reclamation, improvement of highways and street paving.
Examinations, expert tests, reports, designs, specifications and estimates.

WOLCOTT C. FOSTER
Civil • Engineer.
Surveys, Estimates, Plans, Specifications and Construction of Water-Works. Reports upon existing or proposed systems.
52 BROADWAY, NEW YORK.

ARTHUR S. HOBBY,
Civil and Sanitary Engineer
No. 227 Main Street.
Cincinnati, Ohio.
Sewerage Systems for Cities and Villages designed and their construction superintended.
Design and construction of manufactories.
Foundations for heavy buildings, and for engines and machinery.
Foundations in bad ground or in water.

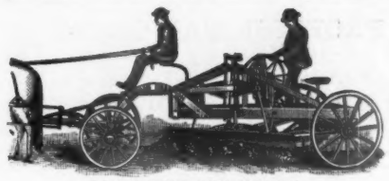
BOOKS

FOR SALE BY
Paving and Municipal Engineering
Chamber of Commerce,
INDIANAPOLIS, IND.

TREATISE ON
LIMES, HYDRAULIC CEMENTS AND MORTARS,
BY GEN. Q. A. GILMORE. Papers on Practical Engineering, United States Engineer Department No. 9, containing reports of numerous experiments conducted in New York City during the years 1858 to 1861, inclusive, with numerous illustrations, 8vo., cloth, $4.00. Sent postpaid on receipt of price.

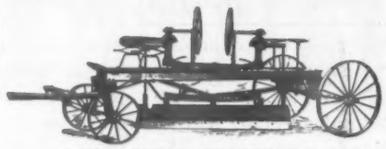
PRACTICAL TREATISE
• • • ON THE • • •
CONSTRUCTION OF ROADS, STREETS AND PAVEMENTS,
BY GEN. Q. A. GILMORE, with 70 illustrations; 12mo. Cloth, $2.00. Sent postpaid on receipt of price.

FOR SALE BY
PAVING AND MUNICIPAL ENGINEERING,
CHAMBER OF COMMERCE,
INDIANAPOLIS, IND.



AMERICAN CHAMPION.

Road and Street Working Implements Of All Kinds.

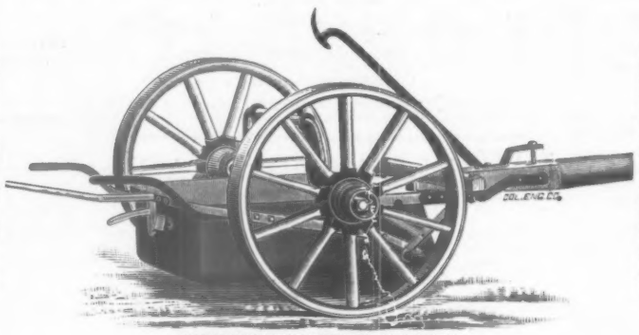


LIGHT STEEL CHAMPION.

THE CHAMPION ROAD MACHINES, as illustrated above, not only have the reputation which entitles them to be called the BEST on the market, but they have the merit. Merit wins in all lines of goods, and never has this fact been more fully demonstrated than in the production of the Champion Machines. They are built thoroughly and of the best material, and combine all of the latest and best improvements known to modern road machines.

They are used and endorsed by the highest authorities on Road Making, and are shipped on trial, thus affording the purchaser an opportunity to judge of their merit before accepting them.

WE ARE PREPARED TO FURNISH AT BOTTOM PRICES ANY IMPLEMENT USED IN ROAD OR STREET BUILDING.



IMPROVED "LITTLE GIANT."

WE SOLICIT YOUR TRADE ON THE BASIS OF FAIR DEALINGS AND GOOD GOODS AT HONEST PRICES.

What has been said of our Road Machines with reference to merit is also applicable in the truest sense of the word to our Wheel and Drag Scrapers.

To those who have become acquainted with the merits and advantages of the old "Little Giant," we would say, the Improved "Little Giant" or No. 1 Wheel Scraper is far superior to it, and the best wheeled Scraper on the market.

STEEL SCRAPER.

Its improvements consist in our New Patent Automatic Dumping Hooks, Independent Steel Axle, Bifurcated Compound Lever and large Steel Bowl.

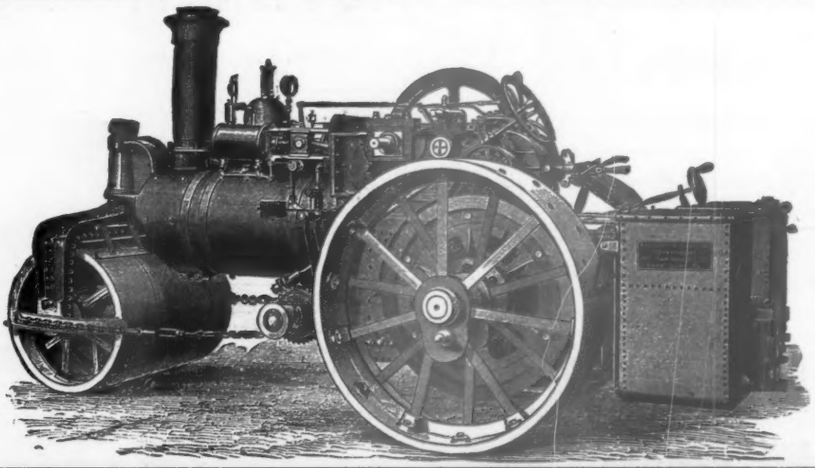
Our "Solid Steel Scrapers" will work easily in any soil, whether plowed or not, and are guaranteed to work easier and clean better than any other Scraper on the market.

In connection with the above, we manufacture the Champion Road Roller and the Champion Steel Rock Crusher.

Write for prices and illustrated catalogue, representing the largest line of Road Working and Earth Handling Implements on the market.

STEEL SCRAPER.

American Road Machine Co., Kennett Square, Pa.



THE HARRISBURG PATENT

DOUBLE ENGINE STEEL

Steam Road Roller

Constructed of the Best Quality of Material Throughout Guaranteed Equal to any

ROLLER IN THE MARKET.

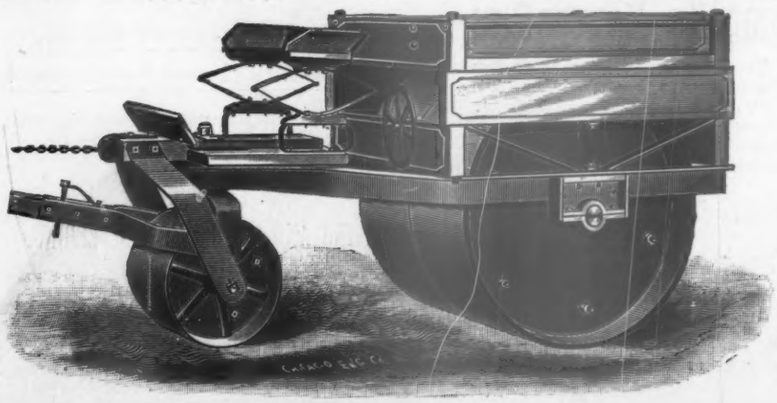
MANUFACTURED BY

Foundry and Machine Department,

HARRISBURG, PA.

SEND FOR CATALOGUE.

ROLLER FOR STREET PAVING



This Roller fills a long-felt want, as many contractors are not justified in purchasing an expensive Steam Roller, nor can afford to shift with a crude or inferior machine not capable of doing good work. Write for description and prices, also for prices on Street-crossing Plates. Address

ENTERPRISE MANUFACTURING CO., COLUMBIANA, OHIO.

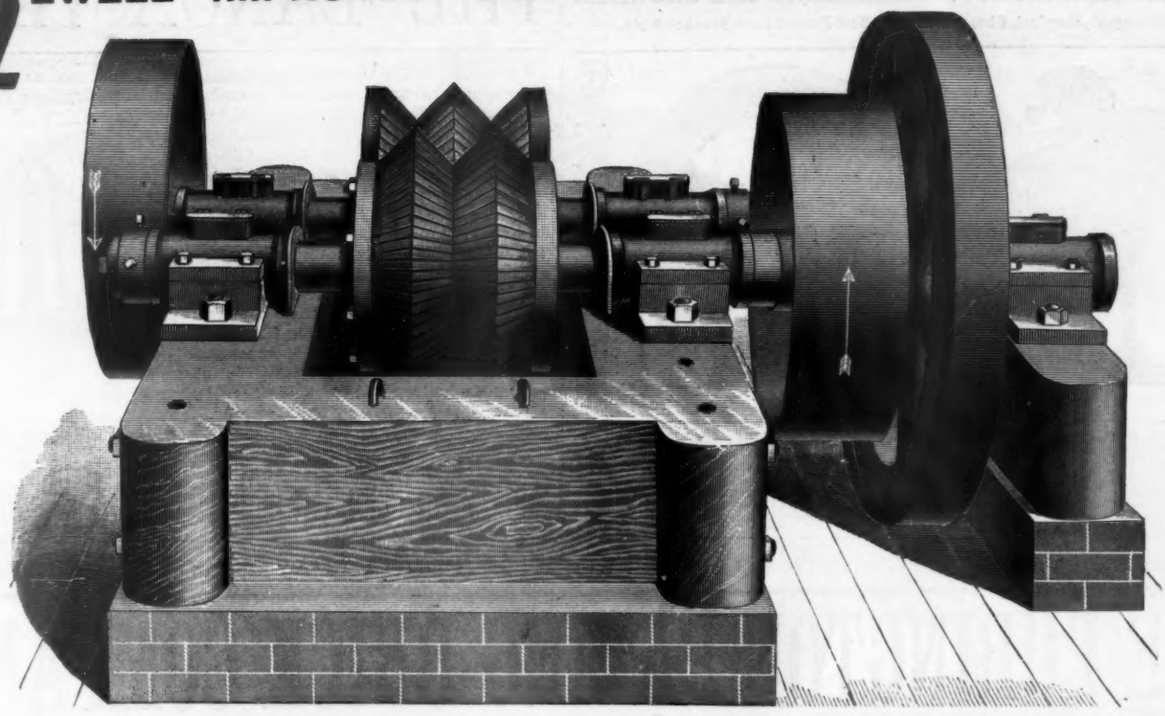
Stubenville, Ohio, February 17, 1891.

To Enterprise Mfg. Co., Columbiana, Ohio:

Gentlemen:—After using the two Rollers which we got from you we stop to congratulate you on the success you have made with your 4-ton Rollers. We have been using them on street gravel; also, almost eight miles of crushed stone Macadam turnpike, rolling the layers of broken stone. It works to perfection. We find the break (lock) a great convenience on hills and moving, and for short turns it beats the world. Four heavy horses will handle on ordinary hill grades, or two horses on the level. We load sometimes to six tons. They will run many years without show of wear. When we get further on with the pike, we will order another of the same.

Yours truly, A. W. McDONALD.

NEWELL · IMPROVED · CLAY · PULVERIZER

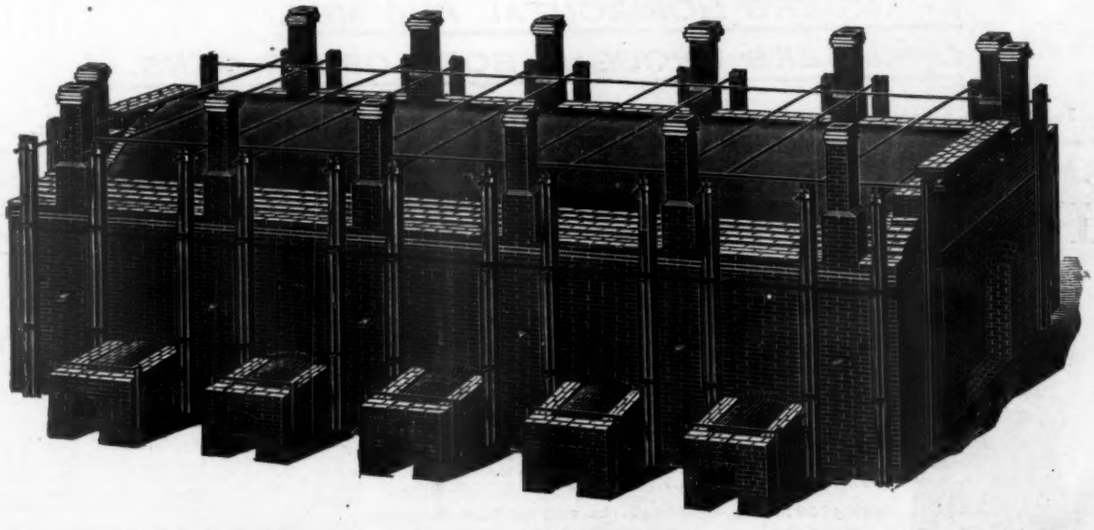


Heavy Cold Rolled Shafts, Running in Best Anti-Friction Metal, Bearings Protected from Dirt.

OUR CLAY PULVERIZER grinds and prepares all clays used for manufacturing purposes thoroughly and economically, and is the only Mill in the market that will crush successfully, clay containing stones, clay dogs, sulphur balls, and other foreign substances, thus enabling manufacturers to make a first-class brick, and saving the wastage of brick where these foreign substances are not ground. We also manufacture special Mills that thoroughly crush slate, which is being largely used for brick making. CORRESPONDENCE SOLICITED.

NEWELL UNIVERSAL MILL CO. **Electrical Exchange Building, 136 Liberty St.**

The ·:· Eudaly ·:· Kiln



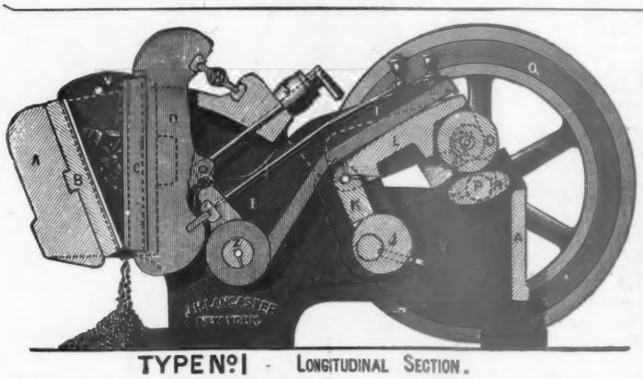
Is No Longer an Experiment. Burns All Hard

This kiln is used by a majority of the largest STREET PAVING BRICK PLANTS in the country. It has no superior for FINE PRESSED OR FRONT BRICK. For further particulars

Address W. A. EUDALY, 64 Johnston's Buildings, Cincinnati, O.

THE LANCASTER ROCK BREAKER AND ORE CRUSHER

The Strongest, Simplest, Cheapest and the Most Perfect Rock Breaker Made.



TYPE No. I - LONGITUDINAL SECTION.

Adjustable while running to instantly yield any desired uniform grades of product.
Half the power only required and is less liable to breakage, and less in first cost and also in subsequent wear and tear, and less weight than any rival's breaker. For crushing rock for concrete these breakers are specially efficient.
The "Lancaster" Crushers are also made in "Sections" for easy transportation in mountainous regions. May be mounted on wheels, worked by hand, horse gear and steam or other power, and also fitted with Rotary Screens, Elevators and Conveyors. Correspondence and trial tests solicited.

THE "LANCASTER"

Will automatically dig, raise and discharge minerals, such as mud, clay, gravel, sand, hard pan, ores, rock phosphates and fire-clay from their beds and banks, and also load and unload vessels or barges with sand, coal ores, grain and other materials. These Grapples are made of best forged steel, with four penetrating scoops, operated solely by compound leverage, thus dispensing with the inside sheaves, drums, catches, gears, chains and friction, found in all rival buckets. They may be worked by hand or horse-power, or by any maker's double drum hoisting engines.

Send for our new illustrated price-list, agency terms and testimonials, and make appointment to see our Rock Breakers, Grapples, Hand, Horse and Steam Power Hoisters at work. Comparison of our prices, capacities and merits with all rival Grapples, Rock Breakers, Hoisters, Etc., earnestly solicited. Licenses to manufacture granted.

☞ Correspondence solicited. Manufactured and sold by the patentee.

Self-Penetrating Grapple, Excavator and Dredger

JAMES H. LANCASTER, (P. O. BOX 3139) 169 AND 171 BROADWAY, NEW YORK, U. S. A.

THE PURINGTON PAVING BRICK COMPANY

OF GALESBURG, ILLINOIS,

Is now operating one of the most expensive and best equipped plants ever established for the manufacture of Paving Bricks.

Mr. D. V. Purington, of Chicago, the President of the Company, is one of the foremost brick makers in the country.

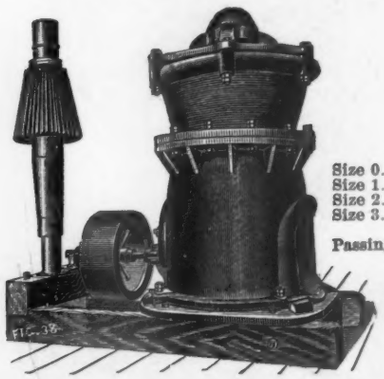
In less than ten years he has ordered and put into operation **ten Chambers Brick Machines,** and with this practical knowledge of their merits his Company at Galesburg uses

THE CHAMBERS BRICK MACHINES,
CHAMBERS HORIZONTAL PUG-MILL,
CHAMBERS WROUGHT BODY DRYER CARS.

IT PAYS TO BUY THE BEST. FOR ADVERTISEMENT CHAMBERS' MACHINERY, SEE LAST PAGE OF COVER.

FOR MAKING ROAD METAL USE THE

GATES ROCK AND ORE BREAKER



OVER **2000** IN USE.

CAPACITY IN TONS OF 2,000 POUNDS.

Size 0	2 to 4 tons per hour.	Size 4	15 to 30 tons per hour.
Size 1	4 to 8 tons per hour.	Size 5	25 to 40 tons per hour.
Size 2	6 to 12 tons per hour.	Size 6	30 to 60 tons per hour.
Size 3	10 to 20 tons per hour.	Size 7	40 to 75 tons per hour.
		Size 8	100 to 150 tons per hour.

Passing 2 1-2 in. ring, according to character and hardness of metal.

Great Saving in Power. Adjustable to any Degree of Fineness. The principle involved in this Breaker acknowledged to be the greatest success ever introduced into Stonebreaking machinery. The Gates Breaker has made more railroad ballast and road metal than all other kinds of breakers combined. **Universally Adopted by Mining Companies. Many Hundreds Used by Railway Companies.** Will furnish a thousand references from Contractors, Street Superintendents, Mines, Cement Manufacturers, etc. Also Manufacture

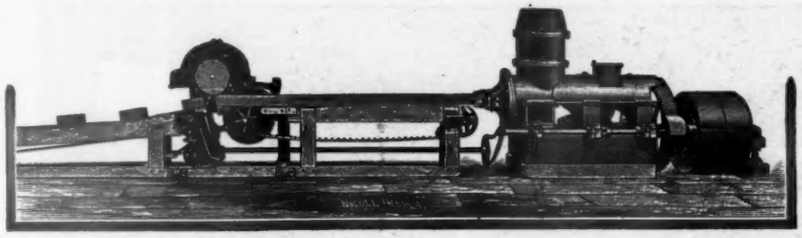
THE CORNISH ROLLS PULVERIZER

Fine Crushing Plants, Concentrators and Other Mining Machinery. Address for Catalogue

73a Queen Victoria St., LONDON.
44 Dey St., NEW YORK.
215 Franklin St., BOSTON, MASS.

Gates Iron Works, 50 R S. Clinton St., Chicago.

THE * LITTLE * WONDER * BRICK * MACHINE



And Cunningham's Automatic

Cutting Table

Send for Illustrated Catalogue.

Mention this Paper.

The Wallace Manufacturing Comp'y

FRANKFORT, INDIANA, U. S. A.

---

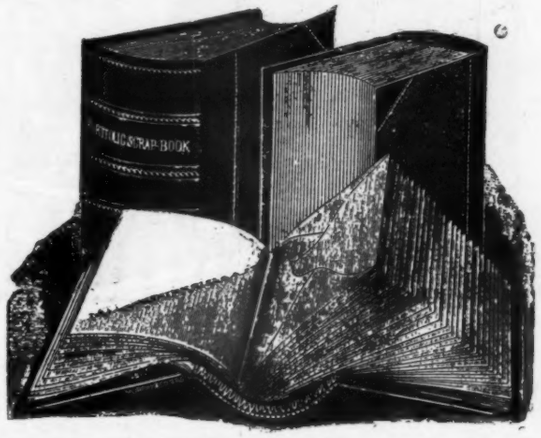
* * BREED'S * *

Patent Portfolio Scrap-Book

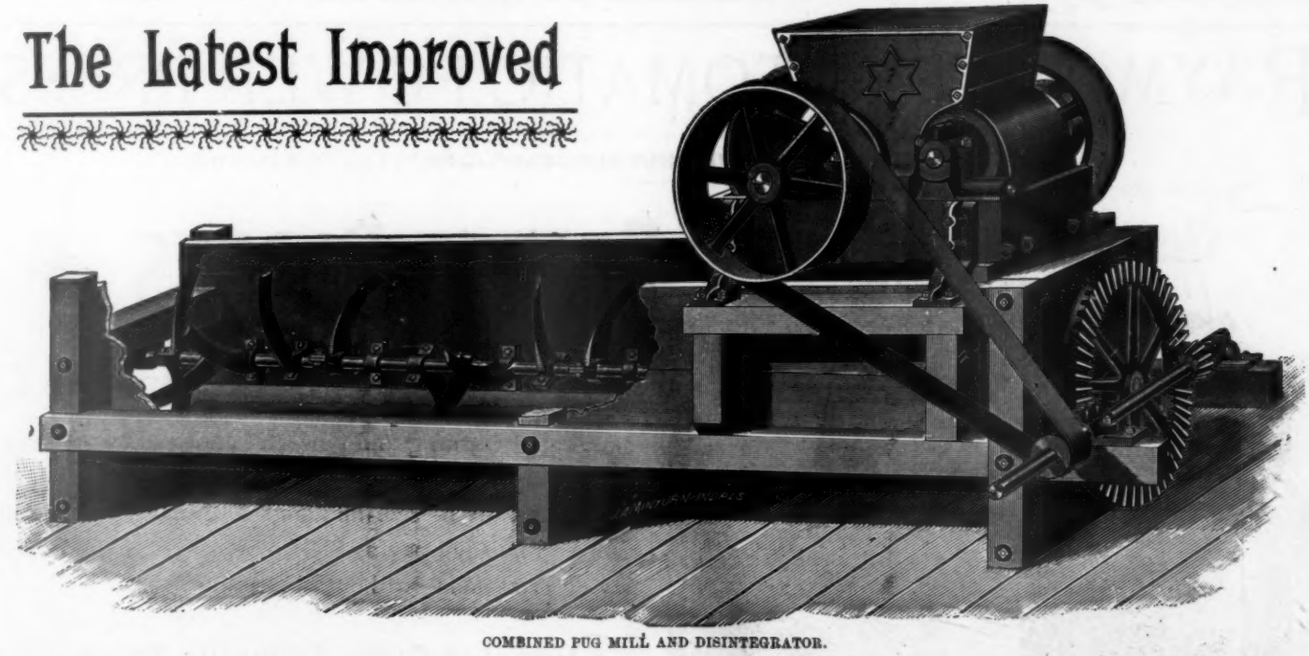
A SCRAP-BOOK WITHOUT PASTE.

The old-fashioned Scrap-book has leaves on which scraps are pasted, as collected, without orderly arrangement. Breed's Scrap-Book has pockets, or envelopes, into which scraps are dropped and methodically filed by subjects. There is no pasting, no annoyance, no loss of time, no dirt! The subject is written on the envelope containing it and entered in the index. No matter how many scraps have accumulated, all upon the same subject are together and can be easily removed, consulted and replaced. Scraps kept in this book are not blurred by pasting, defaced by exposure or mutilated by removal. Notes for editorials, sermons, lectures and other addresses can be filed here, and a record of time and place of delivery be written on the envelope. As a receptable for scraps, papers and writings, *methodically arranged for convenient reference*, it has no equal. It contains fifty heavy manila envelopes, with tuck, 6x9 inches in size, handsomely bound together in a book that stands upon an ordinary book-shelf. Half Amer. Russia, cloth sides. Price, post-paid, $3 net.

THE BOWEN-MERRILL CO., INDIANAPOLIS, IND.



The Latest Improved



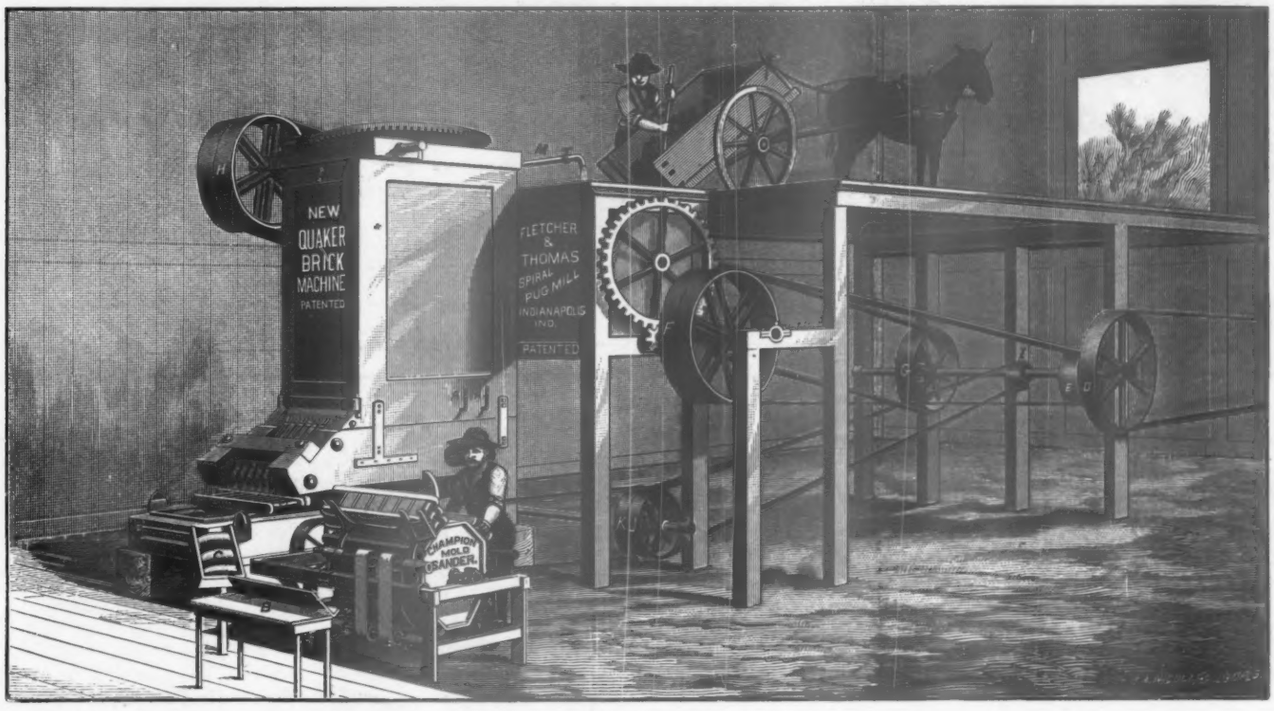
COMBINED PUG MILL AND DISINTEGRATOR.

Brick & Clay Working Machinery

We are prepared to erect complete plants of any desired capacity, and keep in stock a full line of BRICK MACHINERY, PUG MILLS, DISINTEGRATORS, Mold Sanders, Clay Cars, Drums and all kinds of Brick-makers' Supplies furnished on short notice. Write for 1890 Catalogue.

C. & A. POTTS & CO., INDIANAPOLIS, IND.

FLETCHER & THOMAS



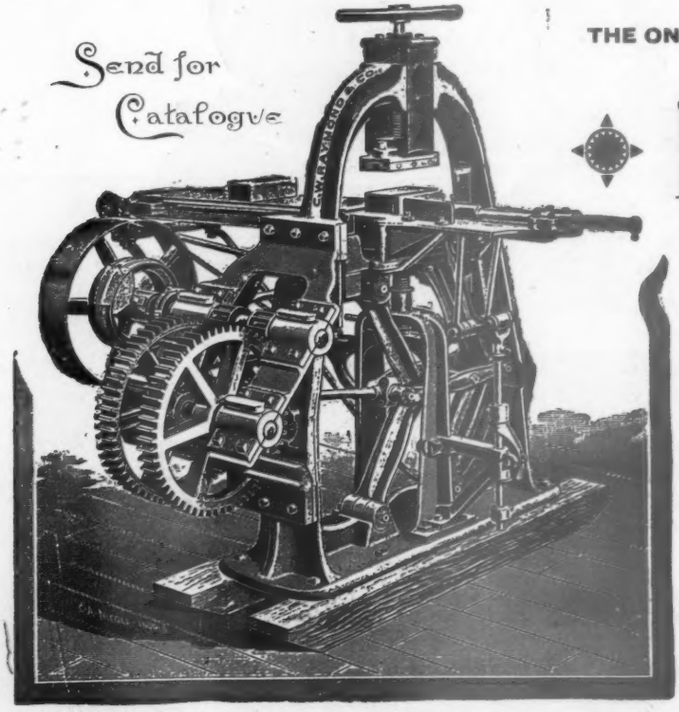
Improved Brick-Making Machinery

The above cut represents the New Quaker Complete Combined Steam Power Outfit. Capacity, 40,000 per day. Capacity of Horse-Power, 15,000 to 20,000. The most perfect machinery for making PAVING BRICKS, FIRE BRICKS or COMMON BRICKS. We make a specialty of equipping yards complete in every detail ready for work. Send for illustrated catalogue.

Correspondence Solicited. FLETCHER & THOMAS, INDIANAPOLIS, INDIANA.

RAYMOND'S AUTOMATIC POWER PRESS

Send for Catalogue



THE ONLY SUCCESSFUL RE-PRESS FOR MAKING

PAVING BLOCKS

RED AND FIRE BRICK, ROOFING TILE, ETC.

A rapid working and powerful machine for pressing paving blocks, by which they are given great density and uniformity of size and finish. Make from 8 to 12 thousand finished paving blocks per day. No first-class paving brick made without re-pressing.

Dumping Cars, Portable Track,
Dryer Cars, Transfer Cars
and General Brick Yard Supplies.

C. W. Raymond & Co., Dayton, Ohio.